Enlargement of Preferential Trade Areas: Essays on Trade Displacement

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ABSTRACT

David L. Buehler: Enlargement of Preferential Trade Areas: Essays on Trade Displacement
(Under the direction of Dr. Alfred Field)

Trade displacement effects caused by the enlargement of a preferential trade area are examined in theory and empirically. The Ricardian model of trade is expanded to four countries to show the trade and welfare effects on members and nonmembers caused by enlargement of a customs union. A simulation follows to help clarify the results. The enlargement of the European Union is examined through a dynamic shift-share analysis and the gravity model is employed to determine the significance of trade displacement. The analysis demonstrates that trade displacement is likely to have occurred with the enlargement of the EU, but the significance of this displacement is not strong.

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DISSERTATION INTRODUCTION

The following collection of essays addresses the concept of trade displacement in international trade. While the terms 'trade creation' and 'trade diversion' have existed since the 1950's as part of the discussion of the trade effects of a customs union or preferential trade agreement, trade displacement has received less attention in the international trade literature. Trade displacement occurs when an existing customs union expands to include new members and entails former members' trade being displaced by the new members. Each of the following essays addresses this effect in different ways.

Trade displacement is first outlined in theory, using a Ricardian trade model adapted to four countries. Using the Dornbusch, Fischer, and Samuelson model of two-country trade and the Appleyard, Conway, and Field three-country model as a foundation, the Ricardian model is expanded to four countries in order to examine the possible enlargement of an existing customs union. A fourth country is needed as there must exist a customs union (of at least two countries), an acceding country, and a country not included in the union. This process of enlargement allows the identification of trade creation, trade diversion, and trade displacement as a result. After the general equilibrium model is presented, a numerical simulation is presented, which allows a clearer picture of the various effects. Welfare analysis in the theory and simulation also demonstrate the potential welfare effects of the enlargement process.

The second chapter examines the export performance of the European countries over the last decade and a half. Using export data, trade displacement would take place if the new

EU members exports to the existing members are taking the place of members' exports to other members. Using a shift-share analysis, export performance is examined after accounting for various other factors, including growth of world trade and market conditions. The analysis shows that the new EU members' exports to the EU have increased fairly dramatically through the sample. Conversely, some of the existing members' exports to EU countries have decreased over the same time period.

Rather than using export data, the final chapter examines import data to attempt to determine the existence of trade displacement. In terms of imports, trade displacement occurs when a member of the customs union begins to import goods from a new member instead of an existing member. The gravity model is employed to estimate the effects on trade from the different country groups – core members, other members, new members, and the rest of the world. More importantly, the changes in these estimates from one period to the next are used to determine the changing nature of trade from the groups to the large EU countries. Some evidence of trade displacement is presented, as the estimation shows increases in imports from the new members combined with decreases or smaller increases in imports from other members.

CHAPTER 1

Trade Displacement in Theory: Evidence from the Ricardian Model

I. Introduction

There has been much theoretical work on the role of integration in international trade, but there has been relatively less work examining the growth of such trade agreements. This paper will further develop the theoretical framework of international trade based on a Ricardian model as presented by Dornbusch, Fischer, and Samuelson (DFS), and later Appleyard, Conway, and Field (ACF). The DFS model outlines the two-country model, and the ACF work extends the framework to three countries, which allows for the examination of different trade agreements between trade partners. This paper adds a fourth country while utilizing the same theoretical framework. The reason for this addition of a fourth country is to add the ability to consider countries potentially joining an existing trade agreement while others remain outside of the agreement. With the addition of a fourth country to the model, this paper will also focus on the theoretical possibility of trade displacement occurring with the enlargement of a preferential trade agreement, in addition to trade creation and trade diversion as outlined by previous literature.

Differing models of international trade suggest that the degree of similarity between partners has an effect of the gains (and costs) of economic integration. In the Ricardian model, as evidenced by ACF, economic integration is most beneficial to those countries that are most *dis*similar. But while the three country model is capable of examining the different possible combinations of integration between countries, it lacks the ability to explore the

effects of potential enlargement of the area of integration on the current members and the remaining countries. This four-country model allows for this investigation into the enlargement of an area of integration in terms of trade effects and welfare analysis, with a focus on trade creation, trade diversion, and trade displacement. The model also permits comparison of potential accession countries, suggesting that current members could have different notions of which non-member should be allowed to integrate. The model is examined with the enlargement of the European Union in mind, though it is presented more generally and is thus not restricted to that particular setting. Ultimately, this paper seeks to answer the questions of how enlargement affects the welfare of current members of a customs union, the acceding country, and those not acceding.

The paper is presented as follows: Section 2 of the paper briefly presents existing literature on the subject. The third section outlines the model used for analysis. A brief description of the model and results from the two-country and three-country models is included before more detail is presented for the four-country case. Section 4 presents the results of the four-country model simulation, including a welfare analysis of the enlargement process. Section 5 concludes.

II. Literature Review

A. Overview

The literature relating to the topics of trade creation, trade diversion, and trade displacement within the Ricardian model will be discussed in the following groups: general theoretical models of customs union[1], work testing for evidence of the three effects, and previous versions of the Ricardian model. The latter will be discussed in separate sections immediately following this section.

[1] For an excellent historical overview of this topic, see Panagariya (2000)

Discussion of literature on customs unions theory begins with Jacob Viner's work *The Customs Union Issue* in 1950, in which Viner first outlines the terms trade creation and trade diversion. Viner's work focused on the welfare effects of the creation of a customs union, and, as a general result, found trade creation – the movement of production from a high cost location to a lower cost location – to have a positive effect on global welfare, while trade diversion – the movement of production from a low cost producer to a high cost producer – has a negative effect on global welfare. Viner's work inspired a series of literature in the 1950's including, but certainly not limited to, the works of James Meade, Franz Gehrels, and Richard Lipsey. One of the main contributions of Lipsey's work included the positive and negative consumption effects of customs union formation along with the production effects.

These early works sparked debate to the merit and effectiveness of customs unions and preferential trade agreements. Much of the policy debate centered around the choice of partners for a preferential trade agreement. On opposite sides of one point of contention were Wonnacott and Lutz (1989) and Summers (1991), who suggested that large initial trade flows between potential PTA members would lead to a positive effect, as trade creation outweighed trade diversion. Bhagwati and Panagariya (1996) disputed this result, showing that high initial trade volumes do not necessarily suggest positive welfare effects for the member countries. The debate continues today, with Eicher, Henn, and Papageorgiou (2008) "revisiting" the issue.

Kemp and Wan's (1976) work included the next significant theoretical outcome, as the authors demonstrated that one could always construct a welfare-improving customs union among countries while the non-members were left, at worst, at their initial levels of welfare.

Much like Viner's work, this theory sparked a series of policy debates, as an important aspect of the Kemp-Wan conclusion relies on the reduction of the common external tariff of the customs union.

The above list of works includes major contributions to the literature regarding customs unions. However, many include only a discussion of the formation of customs unions or preferential trade agreements, and hardly touch on the subject of the enlargement of such an area. One example that does briefly discuss this topic is Ronald Wonnacott's 1996 paper, in which the author mentions that the expansion of a customs union will reverse trade diversion caused by the initial formation of the union. However, Wonnacott does not get into the details of the theory of this process as I attempt to. Welfare effects of a joining nation have been sparsely addressed, with Williams (1972) leading the way. I aim to examine the effects of the enlargement of a customs union – in terms of trade creation, diversion, and displacement – on initial members of a customs union, a joining member, as well as those not joining the customs union. While the ideas of trade creation and trade diversion have existed in the literature since Viner, the theoretical literature on trade displacement is far more insubstantial.

Attempts to empirically isolate the effects of trade creation and trade diversion typically involve the examination of one particular regional integration and/or one particular sector of trade. Few, however, address the issue of an expanding customs union or preferential trade agreement, and thus, few explore the significance of trade displacement effects of such an enlargement. The work in this area is more recent, with Wilhelmsson (2006) examining the trade displacement effects of the expanding EU, and Fratianni and Oh (2007 & 2009) include expanding regional trade agreements in their analysis. All three use

the gravity model to test the effects. Wilhelmsson, in particular, specifically addresses the trade displacement effect through enlargement.

Extensions of the Dornbusch, Fischer, and Samuelson (DFS) version of the Ricardian trade model are not new, but have also not lost influence or importance. Various scholars continue to use the model as a basis for examination of various issues in international trade. More recent examples of the extensions of the model include several papers by Kiminori Matsuyama (2006), and the model also serves as the foundation for recent additions to international trade literature by John Romalis (2004). Matsuyama has expanded the Ricardian model (and more specifically, the DFS model) in several different ways, including examining the inclusion of multiple factors and technologies dependent on destination (home or foreign), and also different demand preferences than the DFS model. Romalis' model is more along the lines of the Heckscher-Ohlin variety and addresses factor proportions and their role in trade, but the basis of the model begins with the DFS model.[2] Other recent examples of DFS extensions include Eaton and Kortum (2002) and Alvarez and Lucas, Jr. (2006), which examine the role of geography in trade, as well as those of country size and tariff policy.

Incorporating the modifications of these various authors into the discussion of regional integration would without doubt prove valuable as well. Building off the original DFS model and addressing regional integration in the same manner as ACF, I will complement these various extensions of the Ricardian models by specifically addressing the enlargement of regional integration. Before doing so, a brief review of the Ricardian model with a continuum of goods in the two and three country settings is presented.

[2] "The model is a combination of the Rudiger Dornbusch et al. (1980) model with a continuum of goods and the Krugman (1981) model of monopolistic competition and transport costs." Romalis (2004).

B. The two-country Ricardian Model with a continuum of goods

The Ricardian model with two countries and a continuum of goods, as outlined by Dornbusch, Fischer, and Samuelson (DFS), determines the competitive margin between exported and imported goods. The model assumes constant unit labor requirements (Assumption 1) for all (n) commodities in both Country 1 and Country 2 (a_1^i and a_2^i; where i represents any good in the continuum). The commodities are indexed so that they are ranked in order of diminishing comparative advantage for country 1, that is

$$a_2^1/a_1^1 > \cdots > a_2^i/a_1^i > \cdots > a_2^n/a_1^n \tag{1}$$

In figure 1.1, this system of indexing, along with the wages in each country, produces the A curve, which draws the export incentive condition. Along the A curve, Country 1 is indifferent between producing the good at home, costing $a_{1i}w_1$, or importing the good from Country 2, costing $a_{2i}w_2$ (given the absence of transportation costs and trade barriers, and assuming an exchange rate of 1). To the left of the A curve, Country 1 has a comparative cost advantage, producing those goods at home for consumption as well as exporting them to Country 2. Similarly, for those goods to the right of the A curve, Country 2 has a comparative cost advantage, and Country 1 chooses to import these goods.

$a_{1i}w_1 < a_{2i}w_2$ left of the A curve

$a_{1i}w_1 = a_{2i}w_2$ along the A curve

$a_{1i}w_1 > a_{2i}w_2$ right of the A curve

The other major determinants in the DFS general equilibrium are the assumptions of identical demands across countries and balanced trade, given by the equation

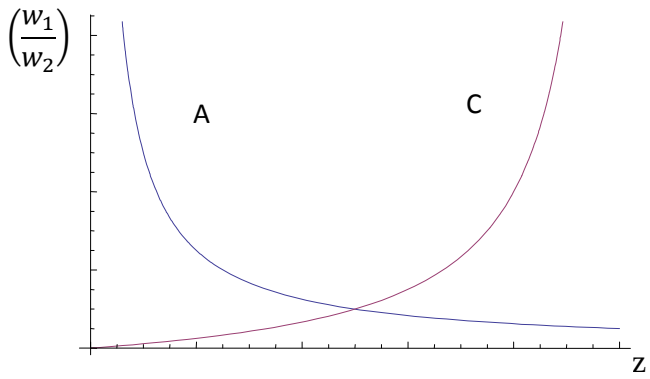
$$\theta_2 w_1 L_1 = \theta_1 w_2 L_2 \tag{2}$$

where$\theta_i$represents the cumulative percentage of income spent on goods through z_i. Using $\theta_2 = 1 - \theta_1$ and rewriting, we have

$$\frac{w_1}{w_2} = \frac{\theta_1}{1-\theta_1}\frac{L_2}{L_1} \tag{3}$$

The intersection of the cost advantage curve (A curve) and the balanced trade curve (C curve) results in the equilibrium wage ratio $\left(\frac{w_1}{w_2}\right)^*$ and the crossover good z*. At the equilibrium wage ratio, Country 1 produces and exports all goods closer to the origin than z*, while it imports all goods further from the origin than z*.

Figure 1.1 – Two country Ricardian model



Adding tariffs to the two country model creates a third area of non-traded goods apart from exports and imports only as in the free trade case. With tariffs in place on imports (reciprocally by both countries), there exists certain goods which Country 1 produces for consumption but does not export. Likewise is true for Country 2. These two cases (two country free trade and two country tariff case) will be examined further using a simulation later in the paper. An important note is that the authors of the DFS paper explore several other scenarios outside of the tariff case in the two country setting. While not critical to the

question at hand, they each have important implications and the reader should find detailed explanations in the original DFS paper.

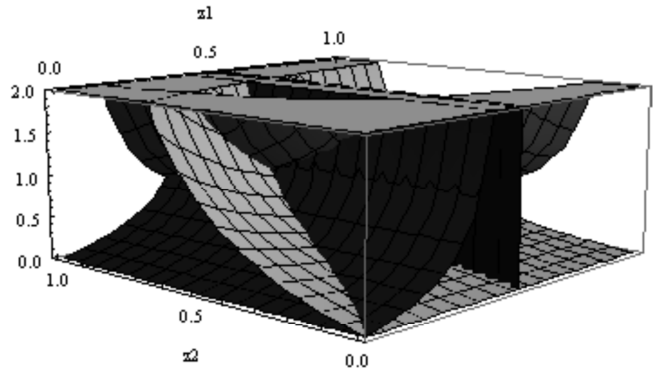
C. The three-country Ricardian model with a continuum of goods

The expansion to three countries, as presented by Appleyard, Conway, and Field (ACF), allows for examination of the effects of trade agreements between pairs of countries. The model is built in a similar fashion to the two country model, indexing the continuum of goods between 0 and 1, and decreasing in terms of country 1's comparative advantage. However, it is important to note that there are essentially two A curves, with $A_2(z)=a_2(z)/a_1(z)$ and $A_3(z)=a_3(z)/a_1(z)$, that map out cost advantages with the respective wage ratios. Combining the comparative cost advantages and a balanced trade restriction, we again see that each country specializes in the production of a set of goods and exports these goods in exchange for each of the other countries' goods. The crossover goods, of which there are two in the three-country setting, are determined by the indexed good where it is cheaper to produce it in country 2 than in country 1 (z_1*) and the indexed good where it is cheaper to produce it in country 3 than in country 2 (z_2*). Figure 1.2 shows the equilibrium for the three-country, free trade case for a general production function. The introduction of tariffs again creates sets of goods (two of them) that are produced for home consumption but not traded.

The introduction of the third country allows, among other things, the analysis of trade agreements between certain members. The policies of one or more countries have effects on the direction of trade, the terms of trade, and the welfare of all three nations (the entire world in this case). However, in the three country model, enlargement of a trade agreement to include a non-member would result in the free trade case, as all countries in the model would

be a member of the union. A fourth country is needed to analyze countries not included in the enlargement process.

Figure 1.2[3] - Three country Ricardian model



III. The four-country Ricardian model with a continuum of goods

A. General Model / Free trade

Four countries are denoted C_i, with i = 1, 2, 3, or 4. An arrayed number of goods are produced (and consumed) and each good is positioned along the continuum [0,1] by variable z.[4] Following ACF, the following assumptions are made about technology, which shows through the labor-output ratio $a_i(z)$. For $A_i(z)=a_i(z)/a_1(z)$:

[3] In the three-country free trade case, there are four equations that must be satisfied: two (binding) export conditions and two balanced trade equations. In the figure, the export condition for C1, which determines z_1*, has been substituted into the other three equations, and those equations are represented by the three planes in the figure. The intersection of the three planes represents the general equilibrium of z_1*, z_2*, and (w_1/w_3)*. (w_1/w_2)* = $A_2(z_1$*) is not represented in the figure.

[4] A specific production function will be introduced in the numerical simulation. See equation 46 on page 25.

$$\frac{\partial A_2}{A_2} \Big/ \frac{\partial z}{z} = \alpha_2 < 0 \tag{4}$$

$$\frac{\partial A_3}{A_3} \Big/ \frac{\partial z}{z} = \alpha_3 < 0 \tag{5}$$

$$\frac{\partial A_4}{A_4} \Big/ \frac{\partial z}{z} = \alpha_4 < 0 \tag{6}$$

$$\alpha_4 < \alpha_3 < \alpha_2 < 0 \tag{7}$$

The first assumption is a standard assumption in the two-country case ensuring the ability to order the commodities in terms of comparative advantage. Adding Assumptions 2-4 ensures that $A_i(z)/A_j(z)$ is increasing in z for $j \leq i$. All together, the assumptions mean that comparative advantage, as z increases, shifts toward countries with a higher i under the assumption that national skill level increases from C_1 to C_2 to C_3 and to C_4.[5]

Countries will import a good from another country if it is more expensive to produce it at home, and likewise, they will have a comparative advantage and export goods for which the country is the lowest-cost producer[6]. For i = 2,3,4, define the wage ratio $\Omega_i = w_1/w_i$. Then country i will export goods z for which the following holds for $j \neq i$:

$$a_i w_i e \leq a_j w_j \tag{8}$$

[5] See ACF (1989) for example of production involving skill-based technology.

[6] With costs of production of $a_i w_i$ in each respective country, there is an implicit assumption that every good on the continuum is produced using identical factor intensities, i.e. labor is equally productive in every industry.

The parameter *e* represents the international exchange rate.[7]

These descriptions of comparative advantage define crossover goods z_1, z_2, and z_3, given by the following equations:

$$\Omega_2 = A_2(z_1) \tag{9}$$

$$\left(\frac{\Omega_2}{\Omega_3}\right) = \left(\frac{A_2(z_2)}{A_3(z_2)}\right) \tag{10}$$

$$\left(\frac{\Omega_3}{\Omega_4}\right) = \left(\frac{A_3(z_3)}{A_4(z_3)}\right) \tag{11}$$

For values below z_1, country 1 produces and exports to all three trading partners. Likewise, country 2 produces goods between z_1 and z_2 and exports to all three partners. For goods between z_2 and z_3, country 3 is the exporter, and for goods above z_3, country 4 is the exporter.

At this moment, it is important to note the role that the Ω's play in this model. Changes in these real wage ratios have an impact on the location in the continuum of the crossover good. As ACF (1989) states, "The real wage ratios can be interpreted as trade-weighted averages of the commodity terms of trade." Hence, when we get away from a free trade situation, policy (tariffs) will not only play a direct role in affecting the location of crossover goods and thus the pattern of trade, but also have an indirect effect through the terms of trade. This is an important note, as partial equilibrium models often ignore this indirect effect. These effects will become clearer in the next example.

The fact that the wage ratios, combined with the unit labor costs, determine the prices of the goods produced demonstrates the perfectly competitive nature of the model. Perfect

[7] The exchange rate will not be influential in the current model, and is assumed to hold a value of 1. Future work may include analysis of the effects of exchange rate policy on the model.

competition in the labor markets implies constant wages across the different industries (but not across countries). As far as the output markets, the prices of the goods are determined by the wages and technology, implying perfectly competitive output markets as well – resulting in the continuum of goods being dubbed a 'continuum of competitive industries'[8] as well. Foreign goods and domestic goods are perfect substitutes, as consumers decide where to purchase goods from based solely on price, and the production results in marginal cost pricing of the goods. Full employment is an additional assumption that is also included in the model.

Conway (2001) is one example of the DFS model extended with relaxed assumptions in the industrial organization. A Ricardo-Viner (RV) model is introduced in comparison to the more traditional DFS model, and firms earn positive profits in this imperfectly competitive model. Some of the important results of this alternate assumption include home wages that are dependent on foreign wages and firms from each country capturing profits according to the difference in relative productivity. Conway also examines an alternative to the full employment assumption. Results of this comparison show the importance of the perfect competition assumption, as the imperfectly competitive RV model demonstrates opposite results from the DFS model in the case of movement of the z values – a critical aspect of the examination of trade policy shocks in the DFS framework.

Following both ACF and DFS using a Mill demand construction, the per capita welfare function of country i is

$$U_i = \int_0^1 E_i\,(z)^{b(z)} dz / L_i \tag{12}$$

[8] Matsuyama (2006)

where L_i is the labor force of country *i*and $E_i(z)$ is the real expenditure on good z in country *i*. Expenditure on each commodity is a constant share b(z) of total expenditure and is identical across countries. The function b(z) is assumed to be strictly positive, and integration on the continuum of goods (for 0 to 1) results in unity. Hence, the demand side of the model follows the traditional, uniform homothetic DFS assumptions that all consumers have identical Cobb-Douglas preferences over the continuum of goods and implies that the fraction of expenditure spent on a subset of goods is $\theta(z_i)$ and is defined by the equation:

$$\theta(z_i) = \int_0^{z_i} b(z)dz > 0 \tag{13}$$

Matsuyama (2000) and Stibora and de Vaal and (2007) demonstrate the results of relaxing these assumptions of the traditional DFS model. By altering the continuum of goods such that higher income household purchase a larger variety of goods (which can be interpreted as necessity and luxury goods), the introduction of non-homothetic preferences demonstrates that within-country income distributions will affect the import and export equilibrium values. Returning to the traditional assumption of homothetic preferences, trade balance conditions are also needed in this equilibrium model, and these represent the simultaneous demand of all countries. Trade balances in the form of imports set to equal exports are given in equations 14 through 17.[9]

$$[1 - \theta(z_1)]w_1L_1 = \theta(z_1)[w_2L_2 + w_3L_3 + w_4L_4] \tag{14}$$

$$[\theta(z_1) + (1 - \theta(z_2))]w_2L_2 = (\theta(z_2) - \theta(z_1))[w_1L_1 + w_3L_3 + w_4L_4] \tag{15}$$

[9] Only three of the four are needed. In the tariff example, we will eliminate the trade balance equation for country 3.

$$[\theta(z_2) + (1 - \theta(z_3))]w_3L_3 = (\theta(z_3) - \theta(z_2))[w_1L_1 + w_2L_2 + w_4L_4] \tag{16}$$

$$\theta(z_3)w_4L_4 = (1 - \theta(z_3))[w_1L_1 + w_2L_2 + w_3L_3] \tag{17}$$

Defining $l_i = L_i/L_1$ and simplifying our notation with:

$$\theta_i = \theta(z_i) \tag{18}$$

we can give normalized trade balance equations in the form:

$$1 = \theta_1 \left[1 + \frac{l_2}{\Omega_2} + \frac{l_3}{\Omega_3} + \frac{l_4}{\Omega_4}\right] \tag{19}$$

$$1 = (\theta_2 - \theta_1) \left[1 + \frac{\Omega_2}{l_2} + \frac{l_3}{\Omega_3}\frac{\Omega_2}{l_2} + \frac{l_4}{\Omega_4}\frac{\Omega_2}{l_2}\right] \tag{20}$$

$$1 = (\theta_3 - \theta_2) \left[1 + \frac{\Omega_3}{l_3} + \frac{l_2}{\Omega_2}\frac{\Omega_3}{l_3} + \frac{l_4}{\Omega_4}\frac{\Omega_3}{l_3}\right] \tag{21}$$

$$1 = (1 - \theta_3) \left[1 + \frac{\Omega_4}{l_4} + \frac{l_2}{\Omega_2}\frac{\Omega_4}{l_4} + \frac{l_3}{\Omega_3}\frac{\Omega_4}{l_4}\right] \tag{23}$$

The equations defining the crossover goods (14-17) combined with the balanced trade equations (19-23) define independent relationships between the variables z_1, z_2, z_3, Ω_2, Ω_3, and Ω_4. The implicit function theorem allows a joint solution of the six endogenous variables and results in the following signs of partial derivatives:

$$\frac{\partial z_1}{\partial l_2} < 0, \qquad \frac{\partial z_1}{\partial l_3} < 0, \qquad \frac{\partial z_1}{\partial l_4} < 0,$$

$$\frac{\partial z_2}{\partial l_2} > 0, \qquad \frac{\partial z_2}{\partial l_3} < 0, \qquad \frac{\partial z_2}{\partial l_4} < 0,$$

$$\frac{\partial z_3}{\partial l_2} > 0, \qquad \frac{\partial z_3}{\partial l_3} > 0, \qquad \frac{\partial z_3}{\partial l_4} < 0,$$

$$\frac{\partial z_2}{\partial l_2} > 0, \qquad \frac{\partial z_2}{\partial l_3} < 0, \qquad \frac{\partial z_2}{\partial l_4} < 0,$$

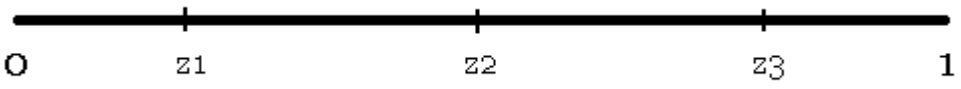
$$\frac{\partial \Omega_2}{\partial l_2} > 0, \qquad \frac{\partial \Omega_2}{\partial l_3} > 0, \qquad \frac{\partial \Omega_2}{\partial l_4} > 0,$$

$$\frac{\partial \Omega_3}{\partial l_2} \quad ?, \qquad \frac{\partial \Omega_3}{\partial l_3} > 0, \qquad \frac{\partial \Omega_3}{\partial l_4} \quad ?,$$

$$\frac{\partial \Omega_4}{\partial l_2} \quad ?, \qquad \frac{\partial \Omega_4}{\partial l_3} \quad ?, \qquad \frac{\partial \Omega_4}{\partial l_4} > 0,$$

Before introducing tariffs into the model, a common misconception about the continuum of goods needs to be addressed. The four-country free trade model results in a trade pattern illustrated by figure 1.3, with each country specializing in the goods in their respective region of the continuum.[10]

Figure 1.3 – Trade pattern for four country free trade



The Ricardian model is sometimes criticized because it lacks intra-industry trade, and there is little empirical evidence that supports complete specialization. These criticisms spawned several new theories of international trade, including, but certainly not limited to,

[10] C1 exports [0,z1] to the other three countries. Likewise, C_2 exports $[z_1,z_2]$, C_3 exports $[z_2,z_3]$ and C_4 exports $[z_3,1]$. The figure is not to scale, and the size of the respective regions is determined by other parameters in the model.

Krugman's model which specifically addressed intra-industry trade. However, the notion of complete specialization in this Ricardian model with a continuum of goods *can* include intra-industry trade.

In this model, complete specialization only implies that a country produces only the goods which it can produce at a lower cost than any other country. However, it does not imply that two countries cannot produce the same type of good. By the construction of the model and the indexing of goods along the continuum from 0 to 1, there is no restriction that two goods from the same industry must be at the same point on the continuum. It is certainly possible for one good from an industry to be indexed at a different point than another good from the same industry. For example, one type of automobile may be indexed very close to 0, meaning it lies in the region in which C_1 is likely to have a comparative cost advantage. Another type of automobile may lie closer to 1 on the index, implying a C_1 comparative cost disadvantage. C_1 is therefore likely to export the first type of automobile, while it is likely to import the second. The ability to include intra-industry trade in the model is a result of the level of disaggregation of the goods along the continuum. If the goods are sufficiently disaggregated, then slightly different goods, which might normally be considered from the same industry, will be represented at different points on the continuum. In fact, as long as the goods are more disaggregated than the level of aggregation that the term 'industry' implies, then the model can include this type of trade. Hence, from this point on, we will assume that the goods in production (all goods produced in the world), are at a minimum level of disaggregation as to include intra-industry trade.

An example of this disaggregation would be the difference between the various levels of aggregation according to the number of digits in the Standard International Trade

Classification (SITC). The level of product homogeneity is very different and more homogenous at the SITC 4-digit level than at the SITC 1-digit level. Therefore, at the 4-digit level, it is more likely that two products with different SITC classifications may be part of the same 'industry' and could be represented at two different points on the continuum. For example, comparing apples (SITC 0574) to oranges (SITC 0571), it's likely that a country would have different cost advantages in their production resulting in different places along the continuum of goods. However, both could easily be considered part of the same industry of fruits and vegetables (SITC 05). It should be noted that, through the modification to imperfect competition, Krugman's model allows for intra-industry trade regardless of the level of disaggregation that the term 'industry' implies.

This description of the disaggregation needed is an important distinction in this model and has important implications in the interpretation of product specialization and trade patterns. For one, the Ricardian model does not restrict intra-industry trade, so the notion of complete specialization only implies production of goods for which a country has a comparative advantage, but not the production of goods from a limited subset of all industries. Second, the expansion (contraction) of region of the continuum that a country exports means that a country does produce a greater (smaller) variety of goods, but it also implies that the volume of trade increases (decreases).

B. Introduction of tariffs

Straying from the free trade model, we can form a similar, more general model with each country levying a tariff on the other three trading partners. The tariffs are assumed to take the form of a uniform ad valorem tariff on all imports coming into the country. Define t_{ij} as the ad valorem tariff levied by country i on imports from country j, so

(24)

$$\tau_{ij} = (1 + t_{ij})$$

Such tariffs will impact the pattern of trade as well as the real wage ratios, or the terms of trade, as demand shifts due to the changes in prices (with tariffs). Countries will now import from the producer with the cheapest tariff-inclusive price. For $k \neq i$ ($k = j$ is permissible, but $\tau_{jj} = 1$), country i will export to country j if and only if

(25)

$$\tau_{ji} a_i w_i \leq \tau_{jk} a_k w_k$$

For each potential trade partner, three inequalities must hold. Consider, for example, country 1's exports to country 2. The exports from country 1 to 2, tariff inclusive, must be cheaper than country 2 producing at home, so $\tau_{21}a_1w_1 \leq a_2w_2$. In addition, exports from country 1 to 2 must be cheaper, tariff inclusive, than exports from country 3 or 4, so $\tau_{21}a_1w_1 \leq \tau_{23}a_3w_3$ and $\tau_{21}a_1w_1 \leq \tau_{24}a_4w_4$. Hence, with four countries, three partners each, and three inequalities, there are a total of 36 inequalities. Of these inequalities, twelve are binding and define twelve crossover goods. However, in some cases, which inequality is binding will be determined by the level of tariffs. For example, examine z_8, which determines the good that is as cheap to produce at home in C_2 as it is to import from C_3. But if τ_{23} is significantly more than τ_{24}, then there might not exist any goods that are cheaper for C_2 to import from C_3 rather than C_4. The crossover goods are defined by equations 26 to 37, along with the other inequalities that need to hold. The inequality in bold type is the binding inequality when tariffs are equal and not prohibitive.

(26a, 26b, 26c)

$$\boldsymbol{\tau_{21}\Omega_2 \leq A_2(z_1)};\ \ \tau_{21}\Omega_3 \leq \tau_{23}A_3(z_1)\ ;\ \ \tau_{21}\Omega_4 \leq \tau_{24}A_4(z_1)$$

(27a, 27b, 27c)

$$\boldsymbol{\tau_{31}\Omega_2 \le \tau_{32}A_2(z_2)};\ \ \tau_{31}\Omega_3 \le A_3(z_2)\ ;\ \ \tau_{31}\Omega_4 \le \tau_{34}A_4(z_2)$$

(28a, 28b, 28c)

$$\boldsymbol{\tau_{41}\Omega_2 \le \tau_{42}A_2(z_3)}\ ;\ \ \tau_{41}\Omega_3 \le \tau_{43}A_3(z_3)\ ;\ \ \tau_{41}\Omega_4 \le A_4(z_3)$$

(29a, 29b, 29c)

$$\boldsymbol{\tau_{12}A_2(z_4) \le \Omega_2}\ ;\ \ \tau_{12}\left(\frac{A_2(z_4)}{A_3(z_4)}\right) \le \tau_{13}\left(\frac{\Omega_2}{\Omega_3}\right)\ ;\ \ \tau_{12}\left(\frac{A_2(z_4)}{A_4(z_4)}\right) \le \tau_{14}\left(\frac{\Omega_2}{\Omega_4}\right)$$

(30a, 30b, 30c)

$$\tau_{32}A_2(z_5) \le \Omega_2\tau_{31}\ ;\ \ \boldsymbol{\tau_{32}}\left(\frac{\boldsymbol{A_2(z_5)}}{\boldsymbol{A_3(z_5)}}\right) \le \left(\frac{\boldsymbol{\Omega_2}}{\boldsymbol{\Omega_3}}\right)\ ;\ \tau_{32}\left(\frac{A_2(z_5)}{A_4(z_5)}\right) \le \tau_{34}\left(\frac{\Omega_2}{\Omega_4}\right)$$

(31a, 31b, 31c)

$$\tau_{42}A_2(z_6) \le \Omega_2\tau_{41}\ ;\ \ \boldsymbol{\tau_{42}}\left(\frac{\boldsymbol{A_2(z_6)}}{\boldsymbol{A_3(z_6)}}\right) \le \boldsymbol{\tau_{43}}\left(\frac{\boldsymbol{\Omega_2}}{\boldsymbol{\Omega_3}}\right)\ ;\ \ \tau_{42}\left(\frac{A_2(z_6)}{A_4(z_6)}\right) \le \left(\frac{\Omega_2}{\Omega_4}\right)$$

(32a, 32b, 32c)

$$\tau_{13}A_3(z_7) \le \Omega_3\ ;\ \ \boldsymbol{\tau_{13}}\left(\frac{\boldsymbol{A_3(z_7)}}{\boldsymbol{A_2(z_7)}}\right) \le \boldsymbol{\tau_{12}}\left(\frac{\boldsymbol{\Omega_3}}{\boldsymbol{\Omega_2}}\right);\ \ \tau_{13}\left(\frac{A_3(z_7)}{A_4(z_7)}\right) \le \tau_{14}\left(\frac{\Omega_3}{\Omega_4}\right)$$

(33a, 33b, 33c)

$$\tau_{23}A_3(z_8) \le \tau_{21}\Omega_3\ ;\ \ \boldsymbol{\tau_{23}}\left(\frac{\boldsymbol{A_3(z_8)}}{\boldsymbol{A_2(z_8)}}\right) \le \left(\frac{\boldsymbol{\Omega_3}}{\boldsymbol{\Omega_2}}\right);\ \ \tau_{23}\left(\frac{A_3(z_8)}{A_4(z_8)}\right) \le \tau_{24}\left(\frac{\Omega_3}{\Omega_4}\right)$$

(34a, 34b, 34c)

$$\tau_{43}A_3(z_9) \le \tau_{41}\Omega_3\ ;\ \ \tau_{43}\left(\frac{A_3(z_9)}{A_2(z_9)}\right) \le \tau_{42}\left(\frac{\Omega_3}{\Omega_2}\right)\ \ ;\ \ \boldsymbol{\tau_{43}}\left(\frac{\boldsymbol{A_3(z_9)}}{\boldsymbol{A_4(z_9)}}\right) \le \left(\frac{\boldsymbol{\Omega_3}}{\boldsymbol{\Omega_4}}\right)$$

(35a, 35b, 35c)

$$\tau_{14}A_4(z_{10}) \le \Omega_4\ ;\ \ \tau_{14}\left(\frac{A_4(z_{10})}{A_2(z_{10})}\right) \le \tau_{12}\left(\frac{\Omega_4}{\Omega_2}\right)\ ;\ \ \boldsymbol{\tau_{14}}\left(\frac{\boldsymbol{A_4(z_{10})}}{\boldsymbol{A_3(z_{10})}}\right) \le \boldsymbol{\tau_{13}}\left(\frac{\boldsymbol{\Omega_4}}{\boldsymbol{\Omega_3}}\right)$$

(36a, 36b, 36c)

$$\tau_{24}A_4(z_{11}) \leq \tau_{21}\Omega_4 \; ; \; \tau_{24}\left(\frac{A_4(z_{11})}{A_2(z_{11})}\right) \leq \left(\frac{\Omega_4}{\Omega_2}\right) \; ; \; \boldsymbol{\tau_{24}\left(\frac{A_4(z_{11})}{A_3(z_{11})}\right) \leq \tau_{23}\left(\frac{\Omega_4}{\Omega_3}\right)}$$

(37a, 37b, 37c)

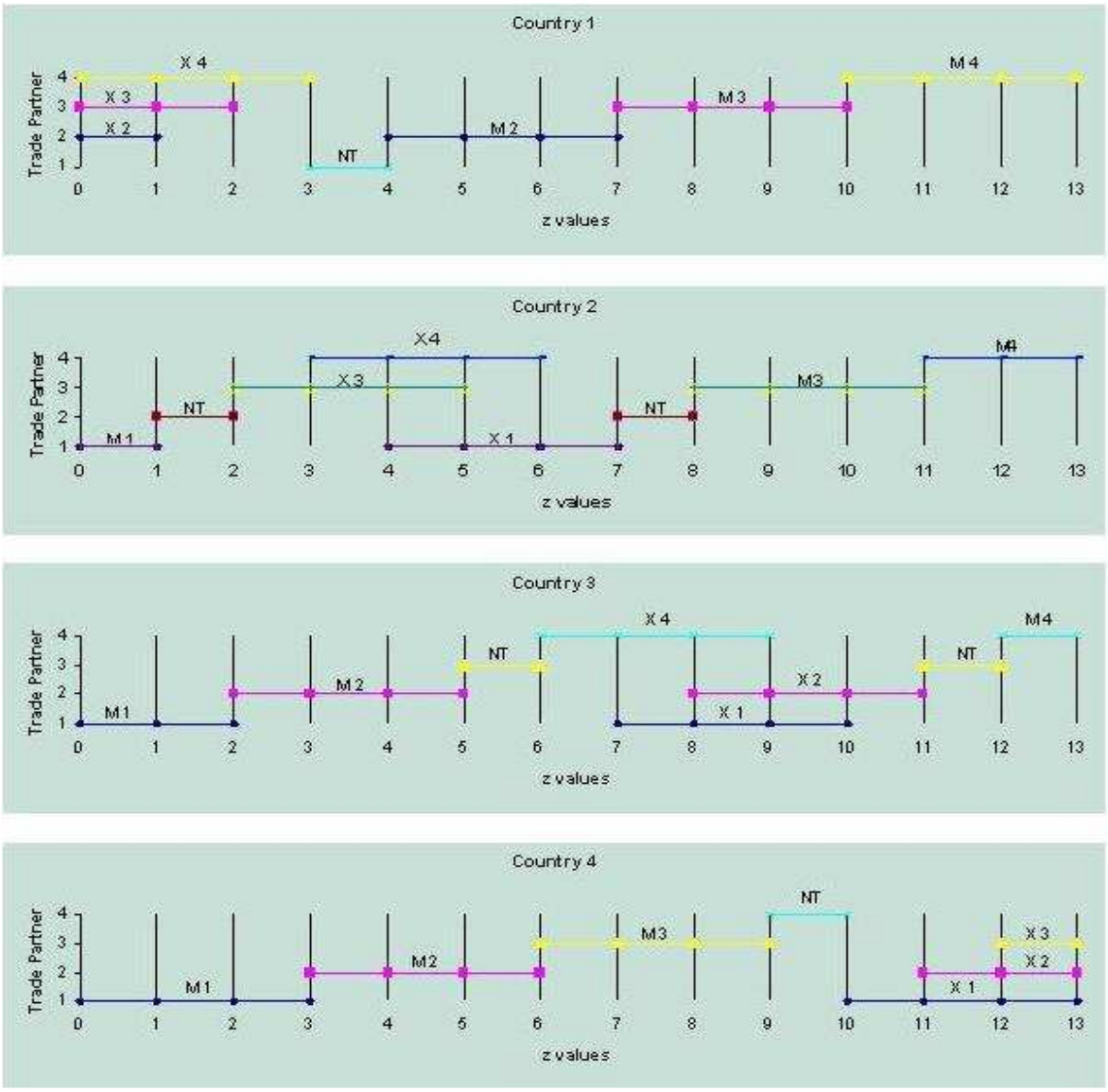
$$\tau_{34}A_4(z_{12}) \leq \tau_{31}\Omega_4 \; ; \; \tau_{34}\left(\frac{A_4(z_{12})}{A_2(z_{12})}\right) \leq \tau_{32}\left(\frac{\Omega_4}{\Omega_2}\right) \; ; \; \boldsymbol{\tau_{34}\left(\frac{A_4(z_{12})}{A_3(z_{12})}\right) \leq \left(\frac{\Omega_4}{\Omega_3}\right)}$$

The resulting trade patterns are indicated in Figure 1.4.[11,12] A few important notes are needed. Each country continues to produce in the general region of the continuum as in the free trade example; that is, country 1 produces the goods with low z values, while country 4 produces those goods with high z values. The tariffs have also caused a region of non-traded goods for each country. Comparison to the free trade example also lends itself to interesting outcomes. With each $\tau = 1$, then $z_1 = z_2 = z_3 = z_4$. Likewise for z_i for i = 5, 6, 7, and 8 or i = 9, 10, 11, 12.

[11] There is potential for $z_i < z_{i+1}$, but that is not necessarily a problem. Some z values may cross over one another, while others can not. In general, z values can not cross over if doing so results in a country both importing and exporting a good. If this occurs, then the binding inequality is not the correct one of the three export conditions. Correcting the binding inequality will disallow both importing and exporting the same goods.

[12] Please note that a z_{13} corresponds to a value of 1, or the upper end of the continuum of goods.

Figure 1.2 – Trade pattern for four country, tariff case



The tariff-inclusive per capita welfare functions are

$$U_1 = \int_0^{z_4} \left[\frac{b(z)}{a_1(z)}\right]^{b(z)} dz + \int_{z_4}^{z_7} \left[\frac{b(z)\Omega_2}{a_2(z)\tau_{12}}\right]^{b(z)} dz + \int_{z_7}^{z_{10}} \left[\frac{b(z)\Omega_3}{a_3(z)\tau_{13}}\right]^{b(z)} dz + \int_{z_{10}}^{1} \left[\frac{b(z)\Omega_4}{a_4(z)\tau_{14}}\right]^{b(z)} dz \quad (26)$$

(27)

$$U_2 = \int_0^{z_1} \left[\frac{b(z)}{\Omega_2 a_1(z)\tau_{21}}\right]^{b(z)} dz + \int_{z_1}^{z_8} \left[\frac{b(z)}{a_2(z)}\right]^{b(z)} dz + \int_{z_8}^{z_{11}} \left[\frac{b(z)\Omega_3}{\Omega_2 a_3(z)\tau_{23}}\right]^{b(z)} dz + \int_{z_{11}}^{1} \left[\frac{b(z)\Omega_4}{\Omega_2 a_4(z)\tau_{24}}\right]^{b(z)} dz$$

(28)

$$U_3 = \int_0^{z_2} \left[\frac{b(z)}{\Omega_3 a_1(z)\tau_{31}}\right]^{b(z)} dz + \int_{z_2}^{z_5} \left[\frac{\Omega_2 b(z)}{\Omega_3 a_2(z)\tau_{32}}\right]^{b(z)} dz + \int_{z_5}^{z_{12}} \left[\frac{b(z)}{a_3(z)}\right]^{b(z)} dz + \int_{z_{12}}^{1} \left[\frac{b(z)\Omega_4}{\Omega_3 a_4(z)\tau_{34}}\right]^{b(z)} dz$$

(29)

$$U_4 = \int_0^{z_3} \left[\frac{b(z)}{\Omega_4 a_1(z)\tau_{41}}\right]^{b(z)} dz + \int_{z_3}^{z_6} \left[\frac{\Omega_2 b(z)}{\Omega_4 a_2(z)\tau_{42}}\right]^{b(z)} dz + \int_{z_6}^{z_9} \left[\frac{b(z)\Omega_3}{\Omega_4 a_3(z)\tau_{43}}\right]^{b(z)} dz + \int_{z_9}^{1} \left[\frac{b(z)}{a_4(z)}\right]^{b(z)} dz$$

which include the optimal demand condition for country i of $E_i(z_k)/L_i = b(z_k)w_i/P_i(z_k)$ for all k and the constant returns pricing condition $P_i(z_k) = a_j(z_k)w_j\tau_{ij}$ for all goods z_k produced in country j, for j = 1,2,3, or 4 (recall, if i=j, then τ_{ij} =1). The consumer faces the tariff-inclusive cost of production of the country with comparative advantage.

Trade balance equations are again needed, and the normalized equations are:[13,14]

[13] As noted earlier, only three of the four countries are required. Country 3 is omitted.

[14] It is assumed that importers pay the tariff and the government redistributes the revenue equally.

$$1 = \theta_1 \frac{l_2}{\Omega_2} + \theta_2 \frac{l_3}{\Omega_3} + \theta_3 \frac{l_4}{\Omega_4} + \theta_4 \tag{30}$$

$$1 = (\theta_7 - \theta_4)\frac{\Omega_2}{l_2} + (\theta_6 - \theta_3)\frac{l_4}{\Omega_4}\frac{\Omega_2}{l_2} + (\theta_5 - \theta_2)\frac{l_3}{\Omega_3}\frac{\Omega_2}{l_2} + (\theta_8 - \theta_1) \tag{31}$$

$$1 = (1 - \theta_{12})\frac{l_3}{\Omega_3}\frac{\Omega_4}{l_4} + (1 - \theta_{11})\frac{l_2}{\Omega_2}\frac{\Omega_4}{l_4} + (1 - \theta_{10})\frac{\Omega_4}{l_4} + (1 - \theta_9) \tag{32}$$

As we approach policy or tariff reform, we are interested in the effects on the trade patterns of changes in tariffs. The changes in the position of the crossover goods are given by equations 33 to 44. Recall that by the assumptions outlined, $\alpha_2 < 0$, $\alpha_2 - \alpha_3 > 0$, and $\alpha_3 - \alpha_4 > 0$. The direct impact of tariff reduction is much clearer, as an increase or decrease in the z value of a crossover good will affect the exports and imports of countries on either side of the good.

$$\hat{z}_1 = \left(\frac{1}{\alpha_2}\right)(\hat{\tau}_{12} + \hat{\Omega}_2) \tag{33}$$

$$\hat{z}_2 = \left(\frac{1}{\alpha_2}\right)(\hat{\tau}_{31} - \hat{\tau}_{32} + \hat{\Omega}_2) \tag{34}$$

$$\hat{z}_3 = \left(\frac{1}{\alpha_2}\right)(\hat{\tau}_{41} - \hat{\tau}_{42} + \hat{\Omega}_2) \tag{35}$$

$$\hat{z}_4 = \left(\frac{1}{\alpha_2}\right)(-\hat{\tau}_{12} + \hat{\Omega}_2) \tag{36}$$

$$\hat{z}_5 = \left(\frac{1}{\alpha_2 - \alpha_3}\right)(-\hat{\tau}_{32} + \hat{\Omega}_2 - \hat{\Omega}_3) \tag{37}$$

$$\hat{z}_6 = \left(\frac{1}{\alpha_2 - \alpha_3}\right)(\hat{\tau}_{43} - \hat{\tau}_{42} + \hat{\Omega}_2 - \hat{\Omega}_3) \tag{38}$$

$$\hat{z}_7 = \left(\frac{1}{\alpha_2 - \alpha_3}\right)(\hat{\tau}_{13} - \hat{\tau}_{12} + \hat{\Omega}_2 - \hat{\Omega}_3) \tag{39}$$

$$\hat{z}_8 = \left(\frac{1}{\alpha_2 - \alpha_3}\right)(\hat{\tau}_{23} + \hat{\Omega}_2 - \hat{\Omega}_3) \tag{40}$$

$$\hat{z}_9 = \left(\frac{1}{\alpha_3 - \alpha_4}\right)(-\hat{\tau}_{43} + \hat{\Omega}_3 - \hat{\Omega}_4) \tag{41}$$

$$\hat{z}_{10} = \left(\frac{1}{\alpha_3 - \alpha_4}\right)(\hat{\tau}_{14} - \hat{\tau}_{13} + \hat{\Omega}_3 - \hat{\Omega}_4) \tag{42}$$

$$\hat{z}_{11} = \left(\frac{1}{\alpha_3 - \alpha_4}\right)(\hat{\tau}_{24} - \hat{\tau}_{23} + \hat{\Omega}_3 - \hat{\Omega}_4) \tag{43}$$

$$\hat{z}_{12} = \left(\frac{1}{\alpha_3 - \alpha_4}\right)(\hat{\tau}_{34} + \hat{\Omega}_3 - \hat{\Omega}_4) \tag{44}$$

It is also clear that the changes in the real wage ratios have an effect on the location of a crossover good in the continuum. Now, the indirect effect of a change in tariff is also evident, as a change in tariff has an effect on the real wage ratio.

A customs union changes several values in the model. First, the internal tariffs are removed. Second, member countries must adopt a common tariff to the non-union countries. For example, consider a union between countries 3 and 4. Internal tariffs are removed, so τ_{34} and τ_{43} are both unitary. This will have a direct negative effect on z_6 and z_{12} (because of the positive relationship and a reduction in tariff), while it has a direct positive effect on z_9.

In addition, other direct effects will be determined by the level of common external tariff the union levies on non-members. If the two union countries had differing tariff rates on a non-member prior to joining, then at least one of their tariffs must be changed, though which tariff and which direction is uncertain. Continuing with example, the non-traded sectors of C_3 and C_4 are eliminated, as $z_9 = z_{10} = z_{11} = z_{12}$ through the combination of the elimination of the internal tariff and the harmonization of the external tariff. The indirect effects also change the crossover values through the changes in the terms of trade.

To continue with the union of countries 3 and 4, with the elimination of the internal tariff, Country 3 has expanded its exports (on the low-end side) to country 4 (z_6 decreases and is equal to z_5). If country 2 is the candidate country, then the elimination of the union's external tariff on country 2 could have effects that reverse the movement caused by the original formation of the union. This is the case, as country 2 expands exports of its high end (which is 3's low end) to country 4 at the loss or reduction of country 3's exports to country 4. We also get the same value of z_i for i = 5, 6, 7, and 8. The indirect effects must be taken into account to correctly identify the direction of the movement of the crossover goods, and the current lack of these effects require caution in interpreting these results. This example is one of many possible scenarios for customs unions and enlargement in this model.

Before discussing the particular trade effects of enlargement, an important note on the welfare functions described by equations 26 through 29 must be made. In this model, welfare is measure of the per capita incomes brought on by the trade pattern and relative wages of the countries. The model discussed in this paper focuses on these parameters – the z parameters, which influence the pattern of trade, and the Ω values, which represent relative wages – and their influence on income changes. It would be naïve, however, to state that

these are the only effects of enlargement. Certainly, other effects such as increased FDI flows are likely to have an effect on overall welfare of a country in addition to the effects discussed in this model.[15] However, this paper will discuss changes in welfare that are isolated to the income changes brought on by changes in trade patterns and relative wages.

Trade Creation, Trade Diversion, and Trade Displacement

With the model now complete, trade creation, trade diversion, and trade displacement effects can be seen. The definitions of these terms will be similar to those in Viner's original work for trade creation and diversion, and similar to Wilhelmson's for trade displacement.

Trade creation is defined by the movement of production from a high-cost producer to a low-cost producer due to a reduction in trade barriers. This is considered to be a positive welfare effect for both countries involved, as both countries face lower prices for a number of goods produced by the other country. Higher-cost home production is replaced by lower-cost foreign production after tariffs are reduced.

Trade diversion occurs when production of a good relocates from a low-cost producer to a high-cost producer due to the preferred status of one country over another. In terms of a customs union, the production of a good relocates from a lower-cost non-member to a higher-cost member country. The move away from more efficient producers is expected to have a negative welfare effect, although it will vary by country. The non-member from which trade is diverted from will certainly have a negative welfare change. While trade diversion likely will result in a welfare decrease due to this movement away from efficient producers, it is possible that global welfare might increase if the consumption effects are very large and outweigh the negative production effects.

[15] See Motta and Norman (1996) and MacDermott (2006) for discussions on the relationship between regional trade agreements and FDI.

Trade displacement is defined by the movement of production from a high-cost member country to a low-cost new member country. For example, suppose there are two countries, A and B, which are members of a customs union with no trade barriers between the two. If another country, C, joins the union, it might now be able to export goods to country A for a cheaper price than country B. Essentially, country B's exports (to A) now face increased competition from country C. Trade displacement can also partially be interpreted as a reduction or reversal of trade diversion. Overall, the movement to a more efficient producer should lead to a net positive welfare effect. However, welfare effects will again vary both in magnitude and direction by country. Identifying these varying effects by country is one of the goals of this paper.

These three effects also show why expanding the model to four countries is necessary. Trade creation occurs whenever two countries reduce trade barriers between one another. The two country model (DFS) accounts for this, as the welfare gains from moving from the base tariff case to free trade are all a result of trade creation. The three country model (ACF) and this four country model also account for trade creation. To examine the effects of trade diversion, however, the model must also include a country that is not a member of the customs union. Hence, the three country model, as well as the four country model, can account for trade diversion while the two country model cannot. Examining the effects of trade displacement requires analyzing the changes when a country becomes a member of the customs union. The three country model can somewhat examine this effect, however, enlargement of any customs union results in all countries becoming members. Without any countries outside of the union, there is no longer a way to examine trade diversion. Hence, this four country model can be used to simultaneously examine trade

creation, trade diversion, and trade displacement, as all requirements are met – two countries forming a union, a country remaining outside of the union, and a country joining the union. In the four country model, the formation of a two country customs union creates both trade creation and trade diversion. Much of the trade creation effect can be seen in the reduction of the region of non-traded goods of the countries that form the union. The member countries increase trade with one another in every case. After the elimination of trade barriers for the members, there is no longer a region of non-traded goods, as if it is cheaper to produce a good in one country, then the other member will import that particular good. Since all goods in the world are exchanged and consumed, that is, every country consumes the entire continuum, the reduction of tariffs will increase trade. However, the increase in trade as a result of a customs union is both trade creating and trade diverting. The difference between the two can be determined by exploring the cheapest production of the good at a particular location of the continuum. At this point, the general equilibrium nature of this model makes this slightly more difficult. Which goods are traded among which countries has an effect on the wage ratios and terms of trade. The wage ratios then determine, along with other parameters, which country is the cheapest producer of goods. Ultimately the cheapest producer will be the country for which $a_{ci}w_c$ is the lowest. So trade creation can been seen in the movement from a higher cost of production to a lower cost of production. In most cases, this is a move from home production and consumption without exporting prior to a customs union to exporting all goods in production.

The trade diversion effects of the formation of a customs union can be seen as a movement from low to high cost production. After trade barriers between the two members are eliminated, trade diversion takes place if a member country imports goods from the other

member country that it was previously importing from elsewhere.[16] Hence, trade diversion takes place whenever

$$a_i w_i \leq \tau_{jk} a_k w_k \leq \tau_{ji} a_i w_i \tag{45}$$

as country j imports from country i after the elimination of tariffs (τ_{ji}) but had previously imported from country k, assuming that $\tau_{ji} = \tau_{jk}$.

Trade creation and trade diversion occur with the formation of a customs union. When that union has a new member enter, trade displacement also takes place. Moving from a two country union to a three country union affects each country in the model in different combinations of trade creation, trade diversion, and trade displacement. For the purposes of the model, there are two member countries, an accession country, and a non-member country.[17] Each of the two members will experience trade creation with the accession country, as well as trade displacement as the new member might replace some of the member countries' exports to the other member. The non-member will experience trade diversion as it experiences a loss of exports to the accession country, which now imports those goods from one of the two members. The accession country will experience all three effects. Trade creation will occur with both members, trade diversion will take place as it changes its source of imports from the non-member to one of the two members, and trade displacement will occur as it becomes the source of imports for one member instead of the other member country.

In more general terms, trade displacement will occur when:

$$a_{new} w_{new} \leq a_{member} w_{member} \leq \tau_{j,new} a_{new} w_{new}$$

[16] The source of imports may change solely due to the changes in the changing wage ratios resulting from the changes in trade between the members, but this is the more general definition of trade diversion.

[17] The non-member can also be interpreted as the rest of the world (ROW).

Where *j* is either of the member countries, *member* is the other member, and *new* is the new member country. The new member is the low cost producer of the good (the first part of the inequality), yet prior to enlargement, had not been the source of imports (the second part) due to the preferential agreement between the two members. The displacement effect will be positive for the new member and one of the members (country *j*), but negative for the other member (*member*). The displacement costs are seen in reduced exports for the other member.

As described in the above model, trade displacement occurs because of the change in the relative prices of the goods. The costs of production also change due to the change in the relative wages, a result of trade remaining balanced according to equations 30-32. For a moment, consider a situation where the relative wages do not change as a result in the change of tariff policy toward the new members. In this hypothetical, the only thing that would change is the tariff-inclusive price paid by consumers. If, prior to enlargement, goods are being imported to a member country from another member – meaning the price is the cost of production in the other member – yet neither is the lowest-cost producer, then there is the potential for trade displacement. Trade displacement occurs after enlargement if the member begins to import from the new member rather than the other member because consumers can now purchase the goods relatively cheaper from the new member. This effect reflects the changes in the trade pattern due to direct price changes.

The changes in the relative wages, however, also have an effect on the pattern of trade, as discussed with the indirect effects (as seen in equations 33-44). These changes in relative wages can cause changes in production costs, which, in turn, can change the source of imports for the countries in the model. Thus, trade displacement occurs because of

changing trade patterns, which is a result of direct price effects as well as indirect relative wage effects. Not all changes in the trade pattern, however, would be considered trade displacement – only those in which the new member replaces a member as the source of goods for another member.

In terms of welfare, the three effects will impact the countries differently through the enlargement of the customs union. The two members experience trade creation with the accession country, which is expected to have a positive effect on their welfare. However, each member will also experience trade displacement *away* from it, which will be a negative welfare effect. Trade displacement *away* from a member implies that the accession country's exports have replaced some of the member's exports to the other member, and the lost income – and the lost imports as a result – produce the negative effects. So the net result on the two members is ambiguous, as the magnitude of the effects will determine the final result. The non-member only experiences trade diversion *away* from it – reduced exports to the members - and is expected to therefore have a negative welfare effect as a result of the customs union enlargement. The accession country experiences trade creation, trade diversion *toward* it – increased exports to the members (at the loss of the non-member) – as well as trade displacement *toward* it – increased exports to the either member which replace exports from one member to the other. All three effects will result in welfare gains for the accession country. The overall world welfare will be determined by the net changes to all four countries. Since the enlargement of the customs union is in general a reduction in trade barriers and a movement toward free trade, one might expect the net world welfare to increase.[18]

[18] In the general sense, this is true. However, there are a number of examples which this might not hold.

The role of country size in the model is another aspect which could have dramatic effects on the results of the enlargement process. In the general form, the expectations of changing relative sizes of countries are similar to the results found in DFS. Assuming that there are no economies of scale present in larger countries, increases in the relative size of a foreign country would drive up the wages of the other countries relative to the now-larger country and also increase the relative share of goods produced by the larger country. Hence, an increase in the size of C_2 would drive the wages of the other countries up relative to C_2 while the goods produced by C_2 would expand. As the goods nearest the crossover goods would be most affected, the effects on C_1 and C_3 would be more dramatic than the effects on C_4 and would be where possible trade displacement has taken place. As in DFS, the country with increasing population would have a decrease in per capita welfare, as the increase in the range of goods produced does not outweigh the decrease in wages.

As part of the discussion of customs union enlargement, and more specifically trade creation, diversion, and displacement effects, the role of country size could increase or decrease the magnitude of these effects depending on whether the larger country is a member, the accession country, or non-member. In the particular case of the accession country being a relatively larger country than the others, the country's inclusion in an existing customs union could possibly have more dramatic effects on the pattern of trade. If the accession country is larger than the members, it would reason that the members would gain more (or be hurt less) by its inclusion. This result would be expected because the members would have greater access to cheaper goods – as the wage in the accession country is driven down by a larger population, so are the goods it produces. At the same time, the accession country now produces a larger set of goods, potentially directly competing even

more with a member country's production. However, the welfare gain for the members caused by the ability to purchase cheaper goods is expected to outweigh the loss caused by a reduction in exported goods. In this sense, the magnitude of trade displacement that occurs may be greater if the accession country is larger, but the overall welfare effects will be positive (or less negative).

Another possibility for country size affecting the trade displacement and welfare of involved countries might occur if one of the members is larger or smaller than the other countries involved. In the case of a larger member country, the expectation is that accession of another country would reduce the gain or increase the loss observed by the member. In other words, the larger the member country is, the less there is to gain (or more to lose) from expansion of an existing customs union. This result is caused by an increase in the importance of trade displacement's effect on the member country.

Isolating these effects requires examination of the movement of the z values as member countries and accession country eliminate tariffs between one another. As discussed earlier, the direct effects (and indirect effects) of tariff changes on the crossover z values will result in changes in trade among all four countries. Due to the large number of possibilities of customs union combinations and different effects of enlargement, a mathematical example will help show these effects. A brief discussion of how the relative country sizes also affect the results will follow as well.

IV. Numerical Simulation

A numerical simulation of the model will clarify the different ramifications of potential enlargement of a customs union. Production technology is given by

$$a_i(z) = \left(\frac{1}{f_i}\right)(z^{-s_i}) \tag{46}$$

so that $a_i(z)$ represents a labor-output coefficient for each country i. Si can be interpreted as skill index for country i, and a country's skill index increases with i, so that country 1 has the lowest skill index (1) and country 4 has the highest (4). This production technology results in monotonically decreasing functions of z, $A_i(z)$. The f_i, which represent a constant technology coefficient unique to a country, are set so that $f_i/f_{i+1} = 0.5$. Labor endowments are assumed to be equal, $L_1=L_2=L_3=L_4$, and expenditure is the same across commodities, $\theta(z) = z$ for all z, which implies identical preferences for goods across the continuum.[19]

With these parameters, many different simulations can be constructed to examine possible customs unions and enlargement. First, the two country model is examined to give a basic sense of the model. Next, the simulation of the three country model is presented, along with the various possible trade agreements.[20] Finally, the simulation of the four country model is presented. With the four country model, there exist the autarky and free trade cases, the base tariff case, and six different two-country unions. For each of these six possible unions, there are two enlargement possibilities. For these simulations, of particular interest are the positions of the crossover goods, the wage ratios, and the welfare of each country. To examine the potential effects of enlargement, initial tariff rates are set at rates of 30%. In addition, by doing this, confirmation and comparison to ACF's results are also possible.

There are many cases examined in separate simulations. First, in the two country setting, free trade and a base tariff case are examined for general introduction. Next, the

[19] Several possible examples where labor endowments are not equal will also be examined.

[20] ACF (1989) presents a simulation of three countries, and this simulation produces identical values for the same parameter settings.

three country model is also outlined in the free trade, base tariff, and the three possible customs unions. Finally, the four country model is introduced with the free trade, base tariff, and the ten possible customs unions[21]. The results are summarized in tables 1.1-1.3.

For the two country model, presented in table 1, the tariffs create a section of non-traded goods between z values of 0.37 and 0.63. The elimination of both tariffs results in each country producing half of the goods, with C1 producing and exporting the "low-skill" half and C_2 producing and exporting the "high-skill" half of the goods.

The results of the three country model simulations, which provide identical crossover z values as presented in Table 2 of ACF (1989), are presented here in table 2 along with wage ratios and nominal utility values.

The results of the four country simulations are presented in table 3. As in the two and three country models, C_1 exports the "low-skill" goods located near zero on the indexed continuum of goods. Increasing z values from zero sees C_2 begin to compete with C1 for lower values of z, then with C_3 for higher values of z. Continuing to move up (or right) along z spectrum, C_3 becomes the exporter until it competes with C_4, and then C_4, with the highest skilled labor force, becomes the exporter of goods with z values located near 1.

The base tariff case is presented first in the table 3. Each country has at least one section of the continuum that is non-traded goods. C_1 exports between 0 and 0.30 and imports goods ranging from 0.40 to 1, leaving the range from 0.30 to 0.40 as non-traded goods for the low-skill country. C_2's non-traded goods range from 0.23 to 0.30 and 0.51 to 0.66. C_3's non-traded goods range from 0.39 to 0.51 and 0.72 to 0.93. C_4's non-traded goods fall in the range from 0.55 to 0.72. One result of different customs unions is the changing – increasing, decreasing, or *moving* – the range on non-traded goods.

[21] In the four country model, there are six possible two country unions and four possible three country unions.

Following the base tariff case are the simulations for the free trade and two-country union cases. The changes in utilities are also presented in table 4[22]. There are several interesting observations. First, C_1 strongly prefers a union with C_4 – nearly three times more than a union with C_3 and about seven times more than a union with C_2. In every case for C_1, a union with partner idrives down the value of Ω_i, while driving the value of Ω_j up for $j \neq i$. However, similar to the results in the three-country model where C_1 preferred C_3 for much the same reason, C_1's choice of C_4 only slightly pushes Ω_4 down while Ω_2 and Ω_3 increase. As a result of C_1 and C_4's union, C_4 also no longer exports any goods to C_3 as a result of the changes in the terms of trade. The union of C_1 and C_4 eliminates both countries ranges of non-traded goods, as the range of exports and imports both increased. From C_1's perspective, C_4 has replaced C_3 as the source for the lower end of the high-skill goods – those goods ranging from 0.59 to 0.72. Welfare analysis shows that a union between C_1 and C_4 results in both countries experiencing increases (although C_1's increase is far greater than C_4's). However, C_2 and C_3 both experience a decrease in welfare as the terms of trade move against them.

The results for single partners of C_2 are similar to that of C_1. C_2 prefers C_4 as a partner over C_3 and C_1. A C_2-C_4 union provides interesting results, and will continue to do so when enlargement of the union is examined. Such an agreement eliminates exports (but not imports) from C_3 to C_2, as well as exports from C_3 to C_4. With the partners 'surrounding' C_3, there is no longer a range of goods for which it is cheaper for either C_2 or C_4 to import from C_3 rather than either produce for itself or import from its partner. Again, there is a

[22] Recall that these discussions of changing values of utility and welfare are isolated to those caused by the changes in trade patterns and relative wages.

welfare gain by both countries in the union while those outside the union experience a welfare decrease.

The simulations show that C_3 would prefer C_4 as a partner, then C_1 followed by C_2. This could be considered a break from expectations, where the one might not consider C_4 to be the most dissimilar union partner. But the agreement with C_4 increases the imports from cheaper producer – eliminating competition on the high-skill goods and non-traded goods, but allows C_3 to produce goods all the way down to 0.41 to export to C_4. The union with C_4 allows C_3 to move its specialization of production for export – both the upper and lower limits – down the continuum. In the base tariff case, C_3 exported goods ranging from 0.51 to 0.72 (while producing from 0.39 to 0.93). After forming a union with C_4, C_3 exports (and produces) goods with z values between 0.41 and 0.71.C_4 also prefers C_3 as a union partner over C_2 and C_1, respectively, although the potential increases in welfare aren't that of the other countries potential gains.

The results for the simulation of the four country model also include the four possible three country unions. In each case, compared to the base tariff case, the country which is left out of the union experiences a welfare loss and an increase in the range of non-traded goods. Values of Ω also increase for the country that is excluded from the union. In the case of CU 234, where C_1 is left outside of the union, all three values of Ω_2, Ω_3, and Ω_4 decrease, showing a decrease in the wage in C_1 relative to that of the other countries. For each of the four countries, there are three possible three-country unions that it can be a part of. In most cases, when compared to the base tariff case, a country prefers the union which includes the highest skilled countries possible. For example, C_1 prefers (in order) CU 134 over CU 124 and CU 123. C_2 prefers CU 234 over CU 124 and CU 123. C_4 prefers CU 234 over CU 134

and CU 124. However, C_3 prefers CU 134 over CU 234 and CU 123. This will be discussed further in the examination of enlargement possibilities.

Central to this paper and the reason that four countries are needed in the model is the examination of potential enlargements of existing customs unions. There are twelve different possible scenarios: there are six possible two country unions, and for each of those, there are two possible accession countries. For example, CU 12 is one of the six possible unions of two countries, and enlargement of the union can happen with either C_3 or C_4 joining the union. The more specific results, including import, exports, and wage ratios/terms of trade can be found in table 3. Values of utility and percentage changes are summarized in table 5. For each of the possible union enlargements, the acceding country experiences a gain in welfare, while the country that remains outside of the union experiences a welfare decrease as it is left outside of the enlargement.

Expansion of CU 12 to include C_4 rather than C_3 is preferred for both C_1 and C_2. For both members, the gain from C_4 accessing is far greater than it would be if C_3 were to join the union. This does not come as a surprise, as we have seen that the low skill countries stand to gain significantly from forming a union with the high skilled country. So it is a reasonable extension that a "low skilled union" would gain from adding a high skill country. Similarly, expansion of CU 13 and CU 23 to include C_4 is preferred for both member countries. In both cases, the lower skill country experiences a larger percentage change in welfare than C_3 when C_4 joins the union. C_3 would gain more than the lower skilled country if the other lower skilled country joined the union (C_3 gains more than C_2 if C_1 joins CU 23, and C_3 gains more than C_1 if C_2 joins CU 13), but the addition of C_4 is preferred in either

situation. The lower skilled country does still experience a welfare increase if the other lower skilled country joins the union in these two cases.

The other three cases – enlargement of CU 14, CU 24, or CU 34 – offer different results. First, examining the enlargement of a union between the two higher skilled countries, C_3 and C_4, shows that the current members may not prefer the same acceding country. C3 experiences a larger gain from including C_1 in the union rather than C_2, while C_4 gains more from including C_2 rather than C_1. C_3 experiences a 1.56% increase in welfare with the addition of C_1 to the union, but only a 0.82% increase if C_2 accedes into the union. Conversely, C_4 experiences a 0.87% increase if C_2 joins the union, compared to a 0.61% increase if C_1 joins. In addition, there is a lot at stake for the two possible acceding countries. If C_1 joins the union, it experiences a 30.7% increase in welfare, while it experiences 3.13% decrease in welfare if C_2 is the country that joins. Likewise, C_2 experiences a 31.35% increase in welfare if it joins CU 34, while it experiences a 5.81% decrease if it remains outside the union while C_1 joins.

The differences in the effects of the enlargement of CU 34 are not surprising. C_4 prefers the higher skilled of the two low-skill countries as a potential partner. However, C_3 is in competition with C_2 as a source for exports, so C_3 has more at stake with the addition of either C_1 or C_2 to CU34. With the addition of C_1 to CU 34, C_3 is able to become a source of exports to C_1 that it was previously importing from C_2.

Enlargement of CU 14 or CU 24 presents another key result of the simulation. Unlike enlargement of CU 34, both current members do prefer one of the acceding countries over the other. In these cases, C_3 is preferred to the other low skilled country in both cases. However, the important result is that, in both enlargement of CU 14 or CU 24, the low skilled

country experiences a decrease in welfare if the other low skilled country is the acceding country. This shows that it is possible for a current member to be worse off after enlargement of the customs union. Looking at enlargement of CU 14, C_1 experiences a 1.37% *decrease* in welfare if C_2 joins the union, versus a 2.52% increase if C_3 accedes into the union. As for the potential members, C_2 experiences a 32.37% increase in welfare if it joins CU 14, and a 4.12% decrease if C_3 joins instead. Meanwhile, C_3 experiences a 19.65% increase in welfare by joining CU 14, and a 0.24% decrease in welfare if it is left outside the union. The increase in welfare for C_2's joining CU 14 represents the largest increase in welfare for any country as a result of forming or joining a customs union in the simulation. Enlargement of CU 24 presents similar results. If C_1 joins the union, C_2 experiences a 0.70% *decrease* in welfare, versus a 0.30% increase in welfare if C_3 were to join. As did C_2 in the previous case, C_1 experiences a significant increase (24.9%) increase in welfare through joining CU 24.

In both of these cases, where welfare potentially decreases as a result of enlargement, it is important to note that both countries had significant increases in welfare due to the original formation of the customs union. As previously seen in table, the greatest possible increase in welfare due to the formation of a (two country) customs union was C_2's 26.84% increase in welfare caused by the formation of CU 24. Second to that is C_1's 24.21% increase in welfare as a result of the formation of CU 14. So in both cases, the low skilled country has gained much by joining the original union. After that, enlargement results in a relatively less increase if C_3 is included, and a decrease if the other low skilled country joins. The simulation also demonstrates that the 'location' of the low-skilled country on the continuum of goods is important. In the model and simulation, C_1 benefits from having no

countries competing on the low end of the continuum. In contrast, C_2, the other low-skilled (but slightly more skilled than C_1) country, must compete with C_1 to provide the other counties with goods. The more similar the two low skilled countries are, the more each would individually gain from union with one of the high skilled countries. In addition, each would have more to lose with the inclusion of the other low-skilled country in that union. Expanding on the discussion of the simulation above, the closer C_1 and C_2 are in skill level, the more each would gain from being a member of CU 14 or CU 24, but the negative effects of either expanding to CU 124 would be greater.

Trade Creation, Trade Diversion, and Trade Displacement

Trade creation, diversion, and displacement effects are all produced in the numerical example. Trade creation occurs when goods that had previously not been traded begin to be after trade is liberalized. Trade diversion occurs when a member begins to import a range of goods from a new member country that it had previously imported from the non-member. Finally, trade displacement occurs when a range of goods that had been previously imported by a member from another member is then imported from the new member after accession. Examination of table 3 allows for the analysis of trade creation, trade diversion, and trade displacement brought on by the enlargement of a customs union. The union possibilities in the three country model (table 2) could be used to examine trade creation and trade diversion, but not trade displacement simultaneously. Table 3 lists the trade patterns, wage ratios, and nominal utility values for each of the two country (six possibilities) and three country (four possibilities) unions.

Let us first examine the example of the enlargement of the customs union between countries 1 and 2 (CU 12). Before looking at the two possibilities for enlargement, a few

notes about CU 12 should be made. First, while $_C1$ exports the same goods to all three other countries, $_C2$ exports a much larger array of goods to C_1 relative to its exports to C_4 and C_3. C_2's exports to C_3 are very small, ranging only from 0.32 to 0.36 on the indexed continuum. Also of note is that C_4's non-traded goods, [.56,.72], is larger than the goods which C_3 exports to C_1 and C_2, [.61,.72].

Either C_3 or C_4 can be the accession country in this first example, forming CU 123 or CU 124. In the former, C_1 continues to produce the same array of goods for export to all three other countries, and thus has little to no effects of trade creation, diversion or displacement with regard to its exports. However, the sources of C_1's imports do change. The array of C_1's imports from C_3 grows in both directions, moving from [.61, .72] to [.53, .82], partially due to trade displacement, and partially due to trade diversion. Trade displacement occurs as the new member's exports (C_3's) displaces some of the other member's exports (C_2's) to C_1.

Examining this effect in more detail shows a clear example of the trade displacement caused by the enlargement of a customs union. Prior to enlargement, C_2 was exporting the range [0.32, 0.61] to its union partner, C_1, while C_3 was exporting [0.61, 0.72] to C_1. After C_3 joins CU 12, C_1 imports goods from C_3 that it had been importing from C_2, namely, the range [0.53, 0.61]. This range of goods represents C_2 exports which have been displaced by exports from the new member.[23]

In terms of welfare, this is beneficial to C_1, as its consumers pay a lower price for those imports. For C_2, this trade displacement has a negative welfare effect. However, C_2 and C_3 both benefit from trade creation between one another as C_3 joins CU 12. C_2's exports

[23] Part of this effect may also be caused by shifts in the wage ratios, but this is a rather explicit example of trade displacement caused by the enlargement of CU 12 to CU 123.

to C_3, which were small initially, grow significantly, as do C_3's exports to C_2. Finally, trade diversion is also occurring. The addition of C_3 to CU 12 causes C_1 and C_2 to import goods from C_3 that it was previously importing from C_4, even though C_4 continues to be the lowest-cost producer.

With the above description of the effects of the enlargement, positive welfare effects are expected for C_1, due to the reduction in prices its consumers face with no significant change in exports, and C_3, due to trade creation with C_2, displacement of exports to C_1 from C_2, and trade diverted to it from C_4 – meaning that C_3's exports to the members have replaced exports from the non-member, C_4. A negative welfare effect for C_4 is expected, as trade is diverted away from it – meaning that its exports to the members have been replaced by the new member. The expected result for C_2's welfare change depends on the magnitude of the effects. The net welfare effect will result from the combination of the positive effect of trade creation with C_3 and the negative effect of the trade displacement of its exports to C_1. In the simulation, the net welfare effect is a positive increase of 5.71%.

The net welfare effect on the world is positive, that is, the gains of C_1, C_2, and C_3 are larger than the welfare loss experienced by C_4. The role of trade displacement plays an interesting one in this outcome. As noted, displacement is expected to have a positive impact on world welfare, as production moves from a high-cost source to a low-cost source. What has essentially happened is that the trade displacement caused by the enlargement of a customs union has reversed some of the effects of trade diversion caused by the original formation of the union. In our CU 123 example, the addition of C_3 to CU 12 eliminates some of the trade diversion that occurred as C_1 and C_2 formed the union. In the CU 12 example, C_3 is the low

cost producer for goods ranging from 0.47 to 0.72.[24] So the original formation of the union caused trade diversion on the upper end of C_2's exports to C_1 (at the expense of C_3's exports), but the inclusion of C_3 in the union reverses this effect.

A similar analysis can be used to examine the effects of C_4 acceding into CU 12 while C_3 remains the non-member. The results are very similar to those above, perhaps even more pronounced. C_1's welfare increases, as C_1's exports remain largely unchanged, it continues to import a fairly large array of goods from C_2, and imports a greater number of goods from C_4. C_2 also experiences a large increase in welfare. There is little trade displacement away from it as in the example above, while it is the recipient of trade diversion (it now exports goods that C_3 can produce at a lower cost). Likewise, C_4 exports more goods to C_1 and C_2, but no longer exports to C_3 at all. Trade is diverted away from C_3 on both ends of its region of production, and the negative welfare effect of this is illustrated.

In the previous section, one of the most peculiar cases was the one that involved the enlargement of CU 24. The initial formation of CU 24 eliminated exports from C_3 to both C_2 and C_4, while C_3 imports from those two countries were reduced dramatically. Conversely, C_1 imported a larger array of goods from C_3 than in the base tariff case. To consider the enlargement of CU 24, allow C_2 and C_4 to be the member countries, C_1 the accession country, and C_3 the non-member.

After enlargement (to CU 124) C_1, the accession country, expands its exports to both C_2 and C_4 from [0, .25] to [0, .32]. Thus, the enlargement to CU124 has caused trade creation between C_1 and C_2, as production moved from the higher cost C_2 to the lower cost

[24] The wage ratios of CU 12 are used to determine the lowest-cost producer. Note that these values will change as the wage ratios change, so the lowest-cost producer of a good may change from one scenario to another. In the movement from CU 12 to CU 123, the goods for which C_3 is the lowest-cost producer changes from [0.47, 0.72] to [0.53, 0.63] using the given wage ratios. This highlights the general equilibrium nature of the model – as wages change, the trade pattern changes. Yet, as the trade pattern changes, the wage ratios also must change.

C_1. However, the increase in trade between C_1 and C_4 is trade displacement (away from C_2). Prior to enlargement, C_2 was exporting the range [.25, .32] to C_4 despite C_1 being the lowest-cost producer as a result of their membership to the CU 24. After enlargement, this trade diversion caused by the initial formation of CU 24 is reversed. The effects on C_3 are significant as well. Instead of exporting a wide array of goods to C_1 only, after enlargement to CU 124, C_3 exports a smaller array of goods to all three countries. Trade has been diverted away from the non-member toward both of the members; that is, C_2 and C_4 both export some goods to C_1 that C_3 could produce at a lower cost.

The summary of the enlargement from CU 24 to CU 124 is thus: trade creation between C_1 and C_2, trade diversion away from C_3 as C_2 and C_4 export goods to C_1 despite C_3 being the lowest cost producer, and trade displacement away from C_2 (to C_1) as C_1 exports goods to C_4 that C_2 previously had. The reason this is a peculiar case is because of the net welfare effects of this enlargement. C_1 has a large, positive gain in welfare, as would be expected with trade creation and 'inward' trade displacement, and it now imports more goods from C_4 than C_3. C_4 also ends up better off, as it receives more goods from the lowest cost producer than it previously had. As anticipated, the welfare of C_3 decreases through the enlargement process, as trade is diverted away from it (and on both ends of its regions of production). The welfare effect of C_2 is the unusual result. C_2 experiences trade creation with C_1, trade diversion (at C_3's expense) and trade displacement away from its production, or outward trade displacement. The net negative welfare effect suggests that the trade displacement effect dominates the trade creation and trade diversion effects.

As noted in the previous section, the enlargement of CU 14 to CU 124 and the two possible enlargements of CU 34 are other interesting cases. The former is very similar to the

case in the previous paragraph, where the accession of C_2 into CU 14 causes significant trade displacement of C_1's exports to C_4 (C2 being the new source of imports for C_4). This negative trade displacement effect on C_1 dominates any positive trade creation and trade diversion effects, and C_1 experiences a net welfare loss while C_2 (accession country) and C_4 (member country) experience a net gain. C_3, the non-member, again experiences a net welfare loss.

While both members experience a net welfare gain through the enlargement of C U34, trade displacement has a significant effect on the magnitude of that gain. The inclusion of C_2 in CU 34 would be preferred by C_4, while C_1 would be preferred by C_3. If C_2 is the accession country, then trade displacement occurs at the expense of C_3 in that C_2 now exports goods to C_4 that C_3 previously had. While not a concern to C_4, some of this trade displacement is eliminated if C_1 were the accession country rather than C_2.

The relative sizes of the countries involved in the enlargement of a customs union is also expected to have an impact on the magnitude of the trade displacement effects caused by enlargement. The impact of differences in labor endowments is important because the enlargement effects are different, as the initial – prior to any customs union and enlargement – trade pattern is altered. A larger country, relative to the example where all countries are of equal sizes, has a lower relative wage and produces a larger section of the continuum of goods. For example, in the base tariff case of the simulation, if C_1 is 1.5 times larger than the other countries, it will produce and export the goods from [0,0.27] to C_2 and [0,0.35] to C_3 and C_4 instead of [0,0.21] and [0,0.30], respectively.

Results from similar simulations as above, yet allowing for changes in the labor endowment of countries 1 and 2, are presented in tables 6a-d and 7. Simulations are

undertaken with both larger and smaller endowments for countries 1 and 2, and the growth of CU 14 and CU 24 to CU 124 is examined. While the growth of CU 14 to include C_2 results in some ambiguity in the role of country size of both the accession and the member country, the enlargement of CU 24 to CU 124 results in the expected changes. With C_1 being the accession country, the larger its labor endowment, the less negative (actually positive) the effect on C_2 of enlargement. This would suggest that the larger C_1, the less the importance of trade displacement relative to that of trade creation. Trade displacement certainly still occurs, as C_1 replaces C_2 as the source for some of C_4's goods as in the original simulation, yet the overall welfare implications are different.

In addition to possible differences in the accession country's labor endowment, the size of the member country would also have an effect on the effects of enlargement. As seen in the enlargement of CU 24 with C_1 acceding, the larger C_2's labor endowment results in a more negative result of enlargement. In the original simulation where labor endowments were equal across all countries, the enlargement of CU 24 to CU 124 caused a decrease in C_2's welfare of 0.7%. If C_2 were 1.5 times the size of the other countries, the decrease in per capita welfare rises to 1.61%. This would suggest that the larger the member country, the greater the relative importance of trade displacement effects.

The changes in the effects of enlargement depend on the size of the countries involved, and the result comes down to the potential income that each country stands to gain or lose directly through its exports and indirectly through its relative wages. In the case of a customs union of CU 24, the larger C_2 is, the wider the array of the continuum that it produces prior to enlargement (see Table 6c), and the larger country size causes its exports to C_4 to 'encroach' on the exports of either C_1 or C_3 to C_4 even more than CU 24 does in the

case where labor endowments are equal[25]. Then, following enlargement to CU 124, the decrease in C_2's exports to C_4 (and C_1's increase) has a greater negative impact on the welfare of C_2.

V. Policy Implications and Conclusions

The expansion of the Ricardian trade model to four countries has allowed the investigation into the results of expansion of trade agreement areas. In some cases, expansion of a customs union resulted in an increase in the welfare of all included countries, and the best potential accession country was the same for both current members. However, in other cases, as the numerical simulation shows, the current members differ on which potential accession country would benefit the home nation the most. In addition and perhaps most influential is the possibility of a member country experiencing a decrease in welfare as a result of expansion of the customs union. For low-skilled countries, the inclusion of another low-skilled country had negative effects on welfare.

These results have interesting policy implications. First, the model suggests that initial formation of a customs union is beneficial to those involved. However, after the initial formation, it may be in one's best interest to prevent others from joining the union. Additionally, the model suggests that it is never beneficial to be left out of the union as it welcomes other countries. In a sense, for some countries, the best policy would be pro-enlargement, but only if they are accession candidates. If they are not a candidate for accession, it's better if no other country is either. If the country does happen to be a candidate for accession, it might be in its best interest to prevent others from being a

[25] As seen in the table 3 and 6a-c, in this simulation, CU 24 eliminates exports from C_3 to C_4. However, when C_2 is sufficiently smaller, as presented in table 6d, then C_1 and C_3 both export to C_4 when CU 24 exists.

potential candidate. And if the country does enter the union, it *may* be better off keeping all others out of the union, but it also *may* be better off letting in additional countries.

The model has allowed insight into the process of enlargement through trade patterns and welfare analysis. While the model itself is general enough to account for all possible variations, the numerical simulation is unique due to the fixed parameters. Variations in the labor endowments resulted in some ambiguity, but other cases did provide the expected results. While no major variations are expected as a result of small changes in these parameters, future work will need to verify this. Along the same lines, the results could potentially change depending on the development levels of the countries involved.

Table 1.1 – Two country simulation

Two Country Case

Base tariff case						
	Country 1	Country 2	Ω_2	0.967	U_1	0.596
Country 1 exports to:		[0, .37]			U_2	0.684
Country 2 exports to:	[.63, 1]					
Free trade case						
	Country 1	Country 2	Ω2	1	U_1	0.708
Country 1 exports to:		[0, .5]			U_2	0.708
Country 2 exports to:	[.5, 1]					

Table 1.2 – Three country simulation

Three Country Case

Base tariff case							
	Country 1	Country 2	Country 3	Ω_2	1.39	U_1	0.911
Country 1 exports to:		[0, .28]	[0, .36]	Ω_3	1.07	U_2	0.700
Country 2 exports to:	[.47, .65]		[.36, .50]			U_3	1.036
Country 3 exports to:	[.65, 1]	[.84, 1]					
Autarky case							
	Country 1	Country 2	Country 3	Ω_2		U_1	0.500
Country 1 exports to:				Ω_3		U_2	0.667
Country 2 exports to:						U_3	1.000
Country 3 exports to:							
Free trade case							
	Country 1	Country 2	Country 3	Ω_2	1.35	U_1	1.129
Country 1 exports to:		[0, .37]	[0, .37]	Ω_3	1.05	U_2	0.837
Country 2 exports to:	[.37, .65]		[.37, .65]			U_3	1.080
Country 3 exports to:	[.65, 1]	[.65, 1]					
1-2 Customs Union							
	Country 1	Country 2	Country 3	Ω_2	1.32	U_1	0.985
Country 1 exports to:		[0, .38]	[0, .38]	Ω_3	1.12	U_2	0.744
Country 2 exports to:	[.38, .77]		[.38, .45]			U_3	1.031
Country 3 exports to:	[.77, 1]	[.77, 1]					
1-3 Customs Union							
	Country 1	Country 2	Country 3	Ω_2	1.51	U_1	1.131
Country 1 exports to:		[0, .25]	[0, .43]	Ω_3	1.07	U_2	0.679
Country 2 exports to:	[.43, .54]		[.43, .54]			U_3	1.058
Country 3 exports to:	[.54, 1]	[.92, 1]					
2-3 Customs Union							
	Country 1	Country 2	Country 3	Ω_2	1.32	U_1	0.873
Country 1 exports to:		[0, .29]	[0, .29]	Ω_3	1.02	U_2	0.830
Country 2 exports to:	[.49, .64]		[.29, .64]			U_3	1.068
Country 3 exports to:	[.64, 1]	[.64, 1]					

Table 1.3 – Four country simulation

Four Country Case

Base tariff case								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.64	U_1	1.500
Country 1 exports to:		[0, .23]	[0, .30]	[0, .30]	Ω_3	1.61	U_2	0.934
Country 2 exports to:	[.40, .51]		[.30, .39]	[.30, .51]	Ω_4	1.12	U_3	1.024
Country 3 exports to:	[.51, .72]	[.66, .72]		[.51, .55]			U_4	1.656
Country 4 exports to:	[.72, 1]	[.72, 1]	[.93, 1]					
Free trade case								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.59	U_1	1.881
Country 1 exports to:		[0, .31]	[0, .31]	[0, .31]	Ω_3	1.56	U_2	1.181
Country 2 exports to:	[.31, .51]		[.31, .51]	[.31, .51]	Ω_4	1.09	U_3	1.207
Country 3 exports to:	[.51, .71]	[.51, .71]		[.51, .71]			U_4	1.721
Country 4 exports to:	[.71, 1]	[.71, 1]	[.71, 1]					
1-2 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.56	U_1	1.552
Country 1 exports to:		[0, .32]	[0, .32]	[0, .32]	Ω_3	1.65	U_2	0.994
Country 2 exports to:	[.32, .61]		[.32, .36]	[.32, .47]	Ω_4	1.14	U_3	1.021
Country 3 exports to:	[.61, .72]	[.61, .72]		[.47, .56]			U_4	1.651
Country 4 exports to:	[.72, 1]	[.72, 1]	[.94, 1]					
1-3 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.74	U_1	1.621
Country 1 exports to:		[0, .22]	[0, .37]	[0, .29]	Ω_3	1.50	U_2	0.913
Country 2 exports to:	[.37, .44]		[.37, .44]	[.29, .54]	Ω_4	1.16	U_3	1.078
Country 3 exports to:	[.44, .84]						U_4	1.657
Country 4 exports to:	[.84, 1]	[.65, 1]	[.84, 1]					
1-4 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.75	U_1	1.863
Country 1 exports to:		[0, .22]	[0, .29]	[0, .37]	Ω_3	1.72	U_2	0.888
Country 2 exports to:	[.37, .51]		[.29, .39]	[.37, .51]	Ω_4	1.11	U_3	1.014
Country 3 exports to:	[.51, .59]	[.66, .77]		[.51, .59]			U_4	1.677
Country 4 exports to:	[.59, 1]	[.77, 1]						
2-3 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.59	U_1	1.496
Country 1 exports to:		[0, .24]	[0, .24]	[0, .32]	Ω_3	1.54	U_2	1.024
Country 2 exports to:	[.41, .52]		[.24, .52]	[.32, .52]	Ω_4	1.13	U_3	1.055
Country 3 exports to:	[.52, .68]	[.52, .89]		[.52, .52]			U_4	1.652
Country 4 exports to:	[.68, 1]	[.89, 1]	[.89, 1]					

2-4 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.56	U_1	1.471
Country 1 exports to:		[0, .25]	[0, .32]	[0, .25]	Ω_3	1.61	U_2	1.184
Country 2 exports to:	[.42, .48]		[.32, .37]	[.25, .60]	Ω_4	1.09	U_3	1.018
Country 3 exports to:	[.48, .74]						U_4	1.688
Country 4 exports to:	[.74, 1]	[.60, 1]	[.96, 1]					
3-4 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.66	U_1	1.461
Country 1 exports to:		[0, .23]	[0, .30]	[0, .30]	Ω_3	1.55	U_2	0.904
Country 2 exports to:	[.39, .54]		[.30, .41]	[.30, .41]	Ω_4	1.09	U_3	1.195
Country 3 exports to:	[.54, .71]	[.70, .71]		[.41, .71]			U_4	1.697
Country 4 exports to:	[.71, 1]	[.71, 1]	[.71, 1]					
1-2-3 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.57	U_1	1.653
Country 1 exports to:		[0, .32]	[0, .32]	[0, .32]	Ω_3	1.49	U_2	1.051
Country 2 exports to:	[.32, .53]		[.32, .53]	[.32, .50]	Ω_4	1.19	U_3	1.106
Country 3 exports to:	[.53, .82]	[.53, .82]					U_4	1.646
Country 4 exports to:	[.82, 1]	[.82, 1]	[.82, 1]					
1-2-4 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.56	U_1	1.837
Country 1 exports to:		[0, .32]	[0, .32]	[0, .32]	Ω_3	1.79	U_2	1.176
Country 2 exports to:	[.32, .57]		[.32, .34]	[.32, .57]	Ω_4	1.08	U_3	1.012
Country 3 exports to:	[.57, .64]	[.57, .64]		[.57, .64]			U_4	1.702
Country 4 exports to:	[.64, 1]	[.64, 1]						
1-3-4 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.85	U_1	1.910
Country 1 exports to:		[0, .21]	[0, .35]	[0, .35]	Ω_3	1.57	U_2	0.852
Country 2 exports to:	[.35, .45]		[.35, .45]	[.35, .45]	Ω_4	1.12	U_3	1.213
Country 3 exports to:	[.45, .70]			[.45, .70]			U_4	1.707
Country 4 exports to:	[.70, 1]	[.73, 1]	[.70, 1]					
2-3-4 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.52	U_1	1.416
Country 1 exports to:		[0, .25]	[0, .25]	[0, .25]	Ω_3	1.50	U_2	1.188
Country 2 exports to:	[.43, .51]		[.25, .51]	[.25, .51]	Ω_4	1.06	U_3	1.204
Country 3 exports to:	[.51, .71]	[.51, .71]		[.51, .71]			U_4	1.711
Country 4 exports to:	[.71, 1]	[.71, 1]	[.71, 1]					

Table 1.4 - Four Country Model; Two Country Unions

	Base Tariff	CU 12	CU 13	CU 14
U_1	1.500	1.552	1.621	1.863
		3.47%	8.09%	24.21%
	Base Tariff	CU 12	CU 23	CU 24
U_2	0.934	0.994	1.024	1.184
		6.46%	9.62%	26.84%
	Base Tariff	CU 13	CU 23	CU 34
U_3	1.024	1.078	1.055	1.195
		5.31%	3.00%	16.67%
	Base Tariff	CU 14	CU 24	CU 34
U_4	1.656	1.677	1.688	1.697
		1.27%	1.93%	2.45%

Table 1.5 - Four Country Model; Union Enlargement Possibilities

	CU 12	CU 123	CU 124		CU 13	CU 123	CU 134		CU 14	CU 124	CU 134
U_1	1.552	1.653	1.837	U1	1.621	1.653	1.910	U1	1.863	1.837	1.910
		6.50%	18.39%			1.95%	17.81%			-1.37%	2.52%
U_2	0.994	1.051	1.176	U2	0.913	1.051	0.852	U2	0.888	1.176	0.852
		5.71%	18.30%			15.11%	-6.69%			32.37%	-4.12%
U_3	1.021	1.106	1.012	U3	1.078	1.106	1.213	U3	1.014	1.012	1.213
		8.33%	-0.89%			2.54%	12.51%			-0.24%	19.65%
U_4	1.651	1.646	1.702	U4	1.657	1.646	1.707	U4	1.677	1.702	1.707
		-0.35%	3.08%			-0.67%	3.03%			1.50%	1.78%
	CU23	CU 123	CU 234		CU 24	CU 124	CU 234		CU 34	CU 134	CU 234
U_1	1.496	1.653	1.416	U1	1.471	1.837	1.416	U1	1.461	1.910	1.416
		10.44%	-5.41%			24.90%	-3.77%			30.70%	-3.13%
U_2	1.024	1.051	1.188	U2	1.184	1.176	1.188	U2	0.904	0.852	1.188
		2.66%	16.05%			-0.70%	0.30%			-5.81%	31.35%
U_3	1.055	1.106	1.204	U3	1.018	1.012	1.204	U3	1.195	1.213	1.204
		4.85%	14.21%			-0.62%	18.32%			1.56%	0.82%
U_4	1.652	1.646	1.711	U4	1.688	1.702	1.711	U4	1.697	1.707	1.711
		-0.37%	3.61%			0.85%	1.39%			0.61%	0.87%

Table 1.6a – Four country case, different endowments

Four Country Case	Country 1's Labor endowment is 1.5 x that of the other countries							
Base tariff case								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.44	U_1	0.830
Country 1 exports to:		[0, .27]	[0, .35]	[0, .35]	Ω_3	1.34	U_2	0.884
Country 2 exports to:	[.45, .54]		[.35, .41]	[.35, .54]	Ω_4	0.91	U_3	1.026
Country 3 exports to:	[.54, .73]	[.70, .73]		[.54, .56]			U_4	1.671
Country 4 exports to:	[.73, 1]	[.73, 1]	[.95, 1]					
Free trade case								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.38	U_1	1.028
Country 1 exports to:		[0, .36]	[0, .36]	[0, .36]	Ω_3	1.28	U_2	1.118
Country 2 exports to:	[.36, .54]		[.36, .54]	[.36, .54]	Ω_4	0.88	U_3	1.202
Country 3 exports to:	[.54, .73]	[.54, .73]		[.54, .73]			U_4	1.746
Country 4 exports to:	[.73, 1]	[.73, 1]	[.73, 1]					
1-4 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.54	U_1	1.010
Country 1 exports to:		[0, .25]	[0, .33]	[0, .42]	Ω_3	1.43	U_2	0.834
Country 2 exports to:	[.42, .54]		[.33, .41]	[.42, .54]	Ω_4	0.89	U_3	1.019
Country 3 exports to:	[.54, .62]	[.70, .81]		[.54, .62]			U_4	1.704
Country 4 exports to:	[.62, 1]	[.81, 1]						
2-4 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.38	U_1	0.815
Country 1 exports to:		[0, .28]	[0, .36]	[0, .28]	Ω_3	1.32	U_2	1.111
Country 2 exports to:	[.47, .52]		[.36, .40]	[.28, .62]	Ω_4	0.89	U_3	1.024
Country 3 exports to:	[.52, .74]						U_4	1.709
Country 4 exports to:	[.74, 1]	[.62, 1]	[.96, 1]					
1-2-4 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.35	U_1	1.001
Country 1 exports to:		[0, .37]	[0, .36]	[0, .37]	Ω_3	1.49	U_2	1.114
Country 2 exports to:	[.37, .59]			[.37, .59]	Ω_4	0.87	U_3	1.017
Country 3 exports to:	[.59, .66]	[.59, .66]		[.59, .66]			U_4	1.729
Country 4 exports to:	[.66, 1]	[.66, 1]						

Table 1.6b - Four country case, different endowments

Four Country Case	Country 1's Labor endowment is 2/3 x that of the other countries							
Base tariff case								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.88	U_1	2.730
Country 1 exports to:		[0, .20]	[0, .27]	[0, .27]	Ω_3	1.95	U_2	0.985
Country 2 exports to:	[.34, .48]		[.27, .37]	[.27, .48]	Ω_4	1.38	U_3	1.024
Country 3 exports to:	[.48, .71]	[.63, .71]		[.48, .54]			U_4	1.645
Country 4 exports to:	[.71, 1]	[.71, 1]	[.92, 1]					
Free trade case								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.85	U_1	3.459
Country 1 exports to:		[0, .27]	[0, .27]	[0, .27]	Ω_3	1.90	U_2	1.244
Country 2 exports to:	[.27, .49]		[.27, .49]	[.27, .49]	Ω_4	1.35	U_3	1.215
Country 3 exports to:	[.49, .70]	[.49, .70]		[.49, .70]			U_4	1.703
Country 4 exports to:	[.70, 1]	[.70, 1]	[.70, 1]					
1-4 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	2.01	U_1	3.438
Country 1 exports to:		[0, .19]	[0, .25]	[0, .32]	Ω_3	2.07	U_2	0.942
Country 2 exports to:	[.32, .48]		[.25, .37]	[.32, .48]	Ω_4	1.38	U_3	1.011
Country 3 exports to:	[.48, .58]	[.63, .75]		[.48, .58]			U_4	1.659
Country 4 exports to:	[.58, 1]	[.75, 1]	[.98, 1]					
2-4 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.78	U_1	2.676
Country 1 exports to:		[0, .22]	[0, .28]	[0, .22]	Ω_3	1.98	U_2	1.258
Country 2 exports to:	[.36, .45]		[.28, .35]	[.22, .58]	Ω_4	1.34	U_3	1.013
Country 3 exports to:	[.45, .74]						U_4	1.672
Country 4 exports to:	[.74, 1]	[.58, 1]	[.96, 1]					
1-2-4 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.82	U_1	3.391
Country 1 exports to:		[0, .28]	[0, .28]	[0, .28]	Ω_3	2.17	U_2	1.244
Country 2 exports to:	[.28, .54]		[.28, .32]	[.28, .54]	Ω_4	1.34	U_3	1.008
Country 3 exports to:	[.54, .62]	[.54, .62]		[.54, .62]			U_4	1.683
Country 4 exports to:	[.62, 1]	[.62, 1]						

Table 1.6c - Four country case, different endowments

Four Country Case	Country 2's Labor endowment is 1.5 x that of the other countries							
Base tariff case								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.74	U_1	1.493
Country 1 exports to:		[0, .22]	[0, .29]	[0, .29]	Ω_3	1.63	U_2	0.590
Country 2 exports to:	[.37, .53]		[.29, .41]	[.29, .53]	Ω_4	1.11	U_3	1.019
Country 3 exports to:	[.53, .74]	[.69, .74]		[.53, .57]			U_4	1.664
Country 4 exports to:	[.74, 1]	[.74, 1]	[.96, 1]					
Free trade case								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.72	U_1	1.876
Country 1 exports to:		[0, .29]	[0, .29]	[0, .29]	Ω_3	1.57	U_2	0.728
Country 2 exports to:	[.29, .55]		[.29, .55]	[.29, .55]	Ω_4	1.08	U_3	1.191
Country 3 exports to:	[.55, .73]	[.55, .73]		[.55, .73]			U_4	1.739
Country 4 exports to:	[.73, 1]	[.73, 1]	[.73, 1]					
1-4 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.84	U_1	1.844
Country 1 exports to:		[0, .21]	[0, .27]	[0, .35]	Ω_3	1.74	U_2	0.564
Country 2 exports to:	[.35, .53]		[.27, .41]	[.35, .53]	Ω_4	1.09	U_3	1.015
Country 3 exports to:	[.53, .61]	[.69, .79]		[.53, .61]			U_4	1.685
Country 4 exports to:	[.61, 1]	[.79, 1]	[1, 1]					
2-4 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.66	U_1	1.454
Country 1 exports to:		[0, .23]	[0, .30]	[0, .23]	Ω_3	1.62	U_2	0.732
Country 2 exports to:	[.39, .51]		[.30, .39]	[.23, .62]	Ω_4	1.07	U_3	1.015
Country 3 exports to:	[.51, .76]						U_4	1.707
Country 4 exports to:	[.76, 1]	[.62, 1]						
1-2-4 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.69	U_1	1.824
Country 1 exports to:		[0, .30]	[0, .30]	[0, .30]	Ω_3	1.83	U_2	0.720
Country 2 exports to:	[.30, .60]		[.30, .35]	[.30, .60]	Ω_4	1.06	U_3	1.011
Country 3 exports to:	[.60, .67]	[.60, .67]		[.60, .67]			U_4	1.723
Country 4 exports to:	[.67, 1]	[.67, 1]						

Table 1.6d - Four country case, different endowments

Four Country Case	Country 2's Labor endowment is 2/3 x that of the other countries							
Base tariff case								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.57	U_1	1.512
Country 1 exports to:		[0, .25]	[0, .32]	[0, .32]	Ω_3	1.60	U_2	1.470
Country 2 exports to:	[.42, .49]		[.32, .38]	[.32, .49]	Ω_4	1.14	U_3	1.029
Country 3 exports to:	[.49, .70]	[.64, .70]		[.49, .54]			U_4	1.651
Country 4 exports to:	[.70, 1]	[.70, 1]	[.91, 1]					
Free trade case								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.50	U_1	1.894
Country 1 exports to:		[0, .33]	[0, .33]	[0, .33]	Ω_3	1.55	U_2	1.899
Country 2 exports to:	[.33, .48]		[.33, .48]	[.33, .48]	Ω_4	1.11	U_3	1.223
Country 3 exports to:	[.48, .70]	[.48, .70]		[.48, .70]			U_4	1.709
Country 4 exports to:	[.70, 1]	[.70, 1]	[.70, 1]					
1-4 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.67	U_1	1.881
Country 1 exports to:		[0, .23]	[0, .30]	[0, .39]	Ω_3	1.71	U_2	1.390
Country 2 exports to:	[.39, .49]		[.30, .38]	[.39, .49]	Ω_4	1.13	U_3	1.014
Country 3 exports to:	[.49, .58]	[.64, .76]		[.49, .58]			U_4	1.672
Country 4 exports to:	[.58, 1]	[.76, 1]	[.99, 1]					
2-4 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.48	U_1	1.494
Country 1 exports to:		[0, .26]	[0, .34]	[0, .26]	Ω_3	1.61	U_2	1.902
Country 2 exports to:	[.44, .46]		[.34, .35]	[.26, .57]	Ω_4	1.12	U_3	1.023
Country 3 exports to:	[.46, .72]	[.57, .57]		[.57, .57]			U_4	1.675
Country 4 exports to:	[.72, 1]	[.57, 1]	[.93, 1]					
1-2-4 Customs Union								
	Country 1	Country 2	Country 3	Country 4	Ω_2	1.46	U_1	1.857
Country 1 exports to:		[0, .34]	[0, .33]	[0, .34]	Ω_3	1.76	U_2	1.913
Country 2 exports to:	[.34, .54]			[.34, .54]	Ω_4	1.10	U_3	1.012
Country 3 exports to:	[.54, .62]	[.54, .62]		[.54, .62]			U_4	1.687
Country 4 exports to:	[.62, 1]	[.62, 1]						

Table 1.7 – Union enlargements, different endowments

Various Country Size Cases

	C_1 is Larger								
	Base	CU 14	CU 124	% change		Base	CU 24	CU 124	% change
U_1	0.830	1.010	1.001	-0.90%	U_1	0.830	0.815	1.001	22.77%
U_2	0.884	0.834	1.114	33.59%	U_2	0.884	1.111	1.114	0.33%
U_3	1.026	1.019	1.017	-0.26%	U_3	1.026	1.024	1.017	-0.75%
U_4	1.671	1.704	1.729	1.46%	U_4	1.671	1.709	1.729	1.17%
	C_1 is Smaller								
	Base	CU 14	CU 124	% change		Base	CU 24	CU 124	% change
U_1	2.730	3.438	3.391	-1.36%	U_1	2.730	2.676	3.391	26.75%
U_2	0.985	0.942	1.244	32.10%	U_2	0.985	1.258	1.244	-1.04%
U_3	1.024	1.011	1.008	-0.33%	U_3	1.024	1.013	1.008	-0.46%
U_4	1.645	1.659	1.683	1.40%	U_4	1.645	1.672	1.683	0.61%
	C_2 is Larger								
	Base	CU 14	CU 124	% change		Base	CU 24	CU 124	% change
U_1	1.493	1.844	1.824	-1.07%	U_1	1.493	1.454	1.824	25.49%
U_2	0.590	0.564	0.720	27.77%	U_2	0.590	0.732	0.720	-1.61%
U_3	1.019	1.015	1.011	-0.33%	U_3	1.019	1.015	1.011	-0.38%
U_4	1.664	1.685	1.723	2.27%	U_4	1.664	1.707	1.723	0.97%
	C_2 is Smaller								
	Base	CU 14	CU 124	% change		Base	CU 24	CU 124	% change
U_1	1.512	1.881	1.857	-1.29%	U_1	1.512	1.494	1.857	24.30%
U_2	1.470	1.390	1.913	37.61%	U_2	1.470	1.902	1.913	0.58%
U_3	1.029	1.014	1.012	-0.18%	U_3	1.029	1.023	1.012	-1.07%
U_4	1.651	1.672	1.687	0.93%	U_4	1.651	1.675	1.687	0.77%

CHAPTER 2

Trade Displacement: Empirical Evidence from a Shift-Share Analysis of the EU

I. Introduction

Economic integration and trade agreements are prevalent in the world today. The role of the North American Free Trade Agreement is an important issue in trade policy in the United States. The European Union has grown both in terms of depth of integration and in members, and recently, the EU has begun to explore the possibility of trade agreements with countries in the Mediterranean region. Specific countries in Asia also belong to a regional free trade agreement, as do countries in South America and Africa as well.

While a significant portion of the literature in the field addresses the effects of integration on the countries involved, literature addressing the growth of such trade agreements is scarcer. While the previous essay examined the theoretical effects of the enlargement of a customs union in the Ricardian Model, this essay will focus on the empirical effects, and more precisely, examine evidence of trade creation, trade diversion, and trade displacement through the enlargement of the European Union. A shift-share, or constant market share, analysis is used to isolate and investigate the magnitudes of the three separate, yet related, trade effects expected to occur as a customs union expands in size.

The purpose of applying the shift-share method on the European countries is to examine the competitive residual trade effects that each group or individual country has experienced after stripping away market and commodity effects. By eliminating market and commodity effects – that is, effects on exports caused by changes in the markets that the

goods are destined for or changes in the demands for certain commodities – a clearer picture of systematic changes in export patterns is visible. It is these changes in exports that are of interest. Trade creation, trade diversion, and more specifically, trade displacement effects can be inferred by looking at the patterns of changes among the various groups or individual countries. Trade displacement effects would be demonstrated by new member countries' exports increasing congruently with a reduction in exports from current members. As data will be intentionally limited to exports that are destined for EU markets, systematic increases in exports from the new members to the EU members combined with reduction of exports from one member to another implies that the sources of international trade is shifting toward the new members.

The application of the shift-share method to EU trade allows for a better examination of the trade displacement effects caused by enlargement. However, as opposed to the discussion in the previous essay, the shift-share results only allow scrutiny of export patterns and not a glimpse into overall welfare. Hence, although increased exports may imply benefits and reduction in exports may imply some losses, net welfare effects are not evaluated. The purpose of this paper is to try to isolate changes in export patterns to establish the presence of trade displacement. As implied in the previous essay, trade displacement would involve positive and negative welfare effects for the countries involved, but there are many other aspects of EU membership that would affect net welfare. Therefore, only these trade effects are examined.

As mentioned, investigating the trade displacement effects caused by the enlargement of the EU is the goal of this paper, yet the expected timing of the effects is not easy to identify. Included in the sample period will be the enlargement of the EU in 1995 to include

Austria, Finland, and Sweden; the 2004 enlargement that added eight Central and Eastern European countries, Malta, and Cyprus; and the 2007 enlargement that included Romania and Bulgaria. However, the trade effects of enlargement on the new and old members are likely to be felt before the actual accession dates. In fact, the 2004 and 2007 accession countries had all signed Europe Agreements well before accession which provided for the liberalization of trade with the EU in most products.[26] For example, Slovakia signed its Europe Agreement in 1993, it went into effect in 1995, and elimination of tariffs on trade with the EU was to occur by the beginning of 2001, followed by the elimination of quantitative restrictions by 2002. Thus, the reduction of trade barriers which causes the trade effects of interest, has occurred over a longer period and was not at a one-time occurrence at accession. For this reason, and because of limited availability of post-enlargement data, the discussion of the changing patterns of trade will in general focus on the entire sample, rather than emphasize pre- and post-accession.

The paper is presented as follows: Section 2 presents the methodology used in the analysis, and the following section discusses the data used. The fourth section presents results of the analysis with data categorized into country groups, while the fifth looks at the results when the countries are kept separate. A sixth section examines the potential policy implications of the study. The final section concludes.

II. Methodology

The shift-share analysis, which is also often called a constant market share analysis, has been used for many years and in other areas as well.[27] Besides using the approach as a

[26] The Europe Agreements came into effect in 1994 for Hungary and Poland, in 1995 for Romania, Bulgaria, Czech Republic, Slovakia, in 1998 for Estonia, Latvia, and Lithuania, and in 1999 for Slovenia.

[27] See Dinc and Haynes (2005) for discussion on uses of the shift-share method in other areas.

way to analyze export growth, the shift share analysis is also a useful tool to examine growth effects in employment, often at the regional level, as in Markussen, Noponen, and Driessen(1991) or Esteban (2000). The method can also be used to analyze one particular country's competitiveness relative to a set of reference economies, and may also be limited to a particular commodity. Chern et al. (2002) is a good example of this, as the authors examine Singapore's export performance of electronics and chemicals relative to other Southeast Asian countries using a dynamic approach. The use of year-to-year data is not very common, and the traditional constant market share analysis, like that of Leamer and Stern (1970), only involves two points in time.

This study of EU trade attempts to blend the background and terminology of Leamer and Stern while including dynamic effects. The spirit of the study is also similar to Chaptea, Gaulier, and Zignago (2005), who use the constant market share approach to look at export performance among 88 countries, including members of the EU. The authors note that the dependence of the members on the internal EU market will have an effect on the competitiveness of their exports in the world market.

To examine the growth in exports of the 27 EU countries, a dynamic shift-share analysis is employed. An important assumption made in this analysis is that each country's share of intra-EU trade should remain constant; that is, each country's exports should grow at the same rate as other EU members. However, this is seldom true, and this analysis allows the above or below average growth to be broken down into a market effect, a commodity composition effect, and a residual or competitiveness effect.

The following definitions are needed to derive the equations for the shift-share analysis:

$V_{i,j}^{t,c}$ = Value of exports from country c to partner j of commodity i in period t.

$r^{t,t+1}$ = Percentage increase in total intra-EU exports from period t to period t+1

$r_i^{t,t+1}$ = Percentage increase in total intra-EU exports of commodity i from period t to period t+1

$r_{i,j}^{t,t+1}$ = Percentage increase in total intra-EU exports of commodity i to partner j from period t to period t+1

From these definitions, we can aggregate over the commodities and destination countries to get the following:

$$\sum_i V_{i,j}^{t,c} = V_{.,j}^{t,c} \quad \sum_j V_{i,j}^{t,c} = V_{i,.}^{t,c} \quad \sum_i \sum_j V_{i,j}^{t,c} = \sum_j V_{.,j}^{t,c} = \sum_i V_{i,.}^{t,c} = V_{.,.}^{t,c}$$

where

$V_{.,j}^{t,c}$ = Total trade from country c to partner j in period t

$V_{i,.}^{t,c}$ = Total intra-EU trade of commodity i from country c in period t

$V_{.,.}^{t,c}$ = Total intra-EU trade of country c in period t

Armed with the above definitions and the constant market share assumption, we can begin to disentangle the different effects through the following identities. Initially, treating exports as one common good, we have

$$V_{.,.}^{t+1,c} - V_{.,.}^{t,c} \equiv r^{t,t+1} V_{.,.}^{t,c} + (V_{.,.}^{t+1,c} - V_{.,.}^{t,c} - r^{t,t+1} V_{.,.}^{t,c})$$

On the left hand side, we have actual growth of EU exports from country (or group) c, and on the right, the first term represents growth at the EU average, and the term in parentheses is the residual above or below that average growth.

Now, considering that exports are a variety of types of goods, we can write the above expression for one particular commodity i:

$$V_{i,.}^{t+1,c} - V_{i,.}^{t,c} \equiv r_i^{t,t+1} V_{i,.}^{t,c} + (V_{i,.}^{t+1,c} - V_{i,.}^{t,c} - r_i V_{i,.}^{t,c})$$

Aggregating this over all commodities results in

$$V_{.,.}^{t+1,c} - V_{.,.}^{t,c} \equiv r^{t,t+1} V_{.,.}^{t,c} + \sum_i (r_i^{t,t+1} - r^{t,t+1}) V_{i,.}^{t,c} + \sum_i (V_{i,.}^{t+1,c} - V_{i,.}^{t,c} - r_i^{t,t+1} V_{i,.}^{t,c})$$

Again, the left hand side represents the actual growth in the value of exports, but we now have three terms on the right hand side. The first term again represents growth at the EU average, the second term is a commodity composition effect, and the third term is again a residual beyond the first two effects. The commodity composition effect is of important note, and can take on a positive or negative value. The sign of this term depends on the makeup of the EU exports. If EU exports of commodity i have grown faster than EU exports as a whole, then $(r_i^{t,t+1} - r^{t,t+1})$ will be positive. After being weighted by $V_{i,.}$, if country c is exporting a greater proportion of products for which exports are growing faster than the overall average, then country c will exhibit a positive commodity composition effect. If the commodity composition effect is negative, then country c is exporting a large share of commodities whose exports are growing at a slower than average rate.

So far, the destination of exports from country c has been any one of the EU countries or the ROW. We can again split this up into any of the 27 possible partners or destination markets for country c's trade. So for one particular commodity exported to one trading partner, we have

$$V_{i,j}^{t+1,c} - V_{i,j}^{t,c} \equiv r_{i,j}^{t,t+1} V_{i,j}^{t,c} + (V_{i,j}^{t+1,c} - V_{i,j}^{t,c} - r_{i,j}^{t,t+1} V_{i,j}^{t,c})$$

Aggregating over both commodities and trading partners results in

$$V_{..}^{t+1,c} - V_{..}^{t,c} \equiv r^{t,t+1} V_{..}^{t,c}$$
$$+ \sum_i (r_i^{t,t+1} - r^{t,t+1}) V_{i,.}^{t,c}$$
$$+ \sum_i \sum_j (r_{i,j}^{t,t+1} - r_i^{t,t+1}) V_{i,j}^{t,c}$$
$$+ \sum_i \sum_j (V_{i,j}^{t+1,c} - V_{i,j}^{t,c} - r_{i,j}^{t,t+1} V_{i,j}^{t,c})$$

This equation is used for most shift-share analysis, and is also used to discover nominal values for the various effects. We again have actual growth in exports on one side of the equation, but now there are four terms on the right hand side. The first term again represents growth in exports at the EU average. The second is the commodity composition effect as described above. The third term is a market effect, and the fourth is again the residual. Like the commodity effect, the market effect can take on a positive or negative value. The term will be positive if a majority of country c's exports are being sent to partners whose imports are growing at a faster rate than the EU average. The market effect is negative for those countries that export a large share of their products to partners that are experiencing slower than average growth in imports.

The residual, which is typically called the competitiveness effect, is an important part of the shift-share analysis. A positive value for the competitiveness effect means that country c's exports have grown faster than if it was to have maintained its market share. This, essentially, is the crux of the analysis. We would like to explore if and how many of the EU countries have been able to maintain market shares as the Union has grown to include many new members.

This analysis of EU trade will make two changes to this standard shift-share analysis. First, the entire identity is divided by the value of trade in the initial year or time period t. As a result, we have

$$\frac{V_{..}^{t+1,c}-V_{..}^{t,c}}{V_{..}^{t,c}} \equiv r^{t,t+1}+\frac{\sum_i (r_i^{t,t+1}-r^{t,t+1})V_{i,.}^{t,c}}{V_{..}^{t,c}}+\frac{\sum_i\sum_j (r_{i,j}^{t,t+1}-r_i^{t,t+1})V_{i,j}^{t,c}}{V_{..}^{t,c}}+\frac{\sum_i\sum_j (V_{i,j}^{t+1,c}-V_{i,j}^{t,c}-r_{i,j}^{t,t+1}V_{i,j}^{t,c})}{V_{..}^{t,c}}$$

Now, each of the terms represents a percentage growth in the value of trade. The first term is the actual increase in the value of exports to the EU countries from country c. The second change will be to move the average growth term to the left hand side to get

$$\frac{V_{..}^{t+1,c}}{V_{..}^{t,c}}-r^{t,t+1}-1 \equiv \frac{\sum_i (r_i^{t,t+1}-r^{t,t+1})V_{i,.}^{t,c}}{V_{..}^{t,c}}+\frac{\sum_i\sum_j (r_{i,j}^{t,t+1}-r_i^{t,t+1})V_{i,j}^{t,c}}{V_{..}^{t,c}}+\frac{\sum_i\sum_j (V_{i,j}^{t+1,c}-V_{i,j}^{t,c}-r_{i,j}^{t,t+1}V_{i,j}^{t,c})}{V_{..}^{t,c}}$$

Now, the left hand side gives exactly what we are attempting to decipher: growth beyond or below what would be expected at the EU average. The right hand side remains the commodity composition effect, the market effect, and the competitiveness effect, respectively, but each is now reported in terms of contribution to growth in values of exports.

As an example, suppose country c experienced a 10% increase of exports between 2000 and 2001, and that average growth for EU exports was 5%. The goal of this analysis is to disentangle why country c's exports grew 5% faster than the rest of the EU. Hypothetically, let the commodity composition effect be 4%, and the market effect is -2%. This would mean that country c is exporting a large share of commodities that EU countries are importing at higher rates than the average for all commodities. On the other hand, country c is exporting a majority of its goods to partners whose imports are growing at a rate slower than the average, and this accounts for a 2% decrease in country c's exports. The positive competitiveness effect means that country c was able to improve its position among its partners, resulting in a 3% increase in its exports.

Another important feature of this analysis is that it includes a dynamic aspect. Many shift-share analyses only compare market shares in an initial year and a final year. This

analysis examines changes during a year-to-year span. The drawback of doing this is that the results will likely be more muted, that is, very prolific changes over a one year period are not expected. However, a dynamic analysis allows us to examine just how the countries' exports have fared leading up to enlargement of the EU, rather than simple before and after snapshots of the process. With the goal of examining changes in the exports of these countries leading up to and through the enlargement process, the benefits of the dynamic analysis will outweigh the drawbacks.

III. Data

The data used for this analysis comes from the United Nations COMTRADE database. Exports are classified into commodity groups among the 1-digit Standard International Trade Classification (SITC) rev. 3 categories, which are presented in Table 2.1.

Table 2.1 SITC Commodity descriptions

SITC 1st digit	Description
0	Food and live animals chiefly for food
1	Beverages and tobacco
2	Crude materials, inedible, except fuels
3	Mineral fuels, lubricants and related materials
4	Animal and vegetable oils, fats and waxes
5	Chemicals and related products, nes
6	Manufactured goods classified chiefly by materials
7	Machinery and transport equipment
8	Miscellaneous manufactured articles
9	Commodities and transactions not classified elsewhere in the SITC

The variable used to evaluate trade is the total value of exports, reported in terms of US dollars. As EU trade is the area of interest in this analysis, the reporters and trading partners are the members of the EU, as well as aggregated data for the rest of the world (ROW). Those countries that recently became members are included in the entire duration of the analysis. For any given year, with 28 possible reporters (EU-27 and ROW), 27 possible partners, and 10 possible commodities, there are more than 7,500 possible data points.

Unfortunately, data on all 27 countries is not available for the entire analysis. The availability of the data for the sample is presented in Table 2.2. This is one of the driving reasons for beginning the analysis in 1994, when 26 countries have data available.

Several additional notes on the data are needed. First, the ROW is treated as a single 'country' outside of the European Union. Therefore, no intra-ROW trade is included in the analysis. For example, U.S.-China bilateral trade is not included in any way. However, any particular European country's trade with *either* the U.S. or China is included. Secondly, it should be noted that Belgium and Luxembourg were treated as one reported by the UN database until 1999, when separate statistics were kept for each country. The data for those countries were aggregated beyond 1999, and are listed as Belgium-Luxembourg.

Table 2.2 Data Availability

Country	Initial Year	Final Year
Austria	1988	2007
Belgium	1999	2007
Belgium-Lux	1988	1998
Cyprus	1989	2007
Czech Rep	1993	2007
Denmark	1988	2007
Estonia	1995	2007
Finland	1988	2007
France	1988	2007
Germany	1991	2007
Greece	1988	2007
Hungary	1992	2007
Ireland	1988	2007
Italy	1988	2007
Latvia	1994	2007
Lithuania	1992	2007
Luxembourg	1999	2007
Malta	1990	2007
Netherlands	1988	2007
Poland	1992	2007
Portugal	1988	2007
Slovakia	1994	2007
Slovenia	1992	2007
Spain	1988	2007
Sweden	1988	2007
United Kingdom	1988	2007

The use of data at the SITC 1-digit level has both benefits and drawbacks. Richardson (1971) points this out as well: "Commodity classifications should be as homogenous as possible, but there may be substantial costs to the collection and processing of highly disaggregated data." The 1-digit level allows for a more manageable data set than more disaggregated data. Secondly, as long as the data can be broken down into both commodity and destination, it is possible to peel away the average, commodity, and market effects from the variable of interest, the competitiveness effects. More disaggregated data, however, would allow a more precise analysis of the exports of the commodities that are growing at faster or slower rates than average. The effect of the level of disaggregation on the overall accuracy of the commodity, market, and competitiveness effects has been debated, with Richardson (1971) suggesting that disaggregation causes fairly substantial changes in the estimations, while Fuchs and Lichtenburg found that changing classifications had little effect on accuracy. Because of the large number of exporters and destination markets, as well as the focus on the changing nature of the competitiveness effects (and not just the values themselves), the SITC 1-digit is employed. Richardson also found that the level of market disaggregation had little effect on the estimates for the competitiveness effects, which is important in the following section.

IV. Analysis by Country Groups

A shift share analysis, as described above, was performed on the 27 European countries with the trade data aggregated into country groupings. The groups were determined in the following ways: The first group includes large members (LMC) of the EU, more specifically those that are included in the top of nominal GDP rankings. The LMC group includes France, Germany, the United Kingdom, Spain, Italy, and Netherlands. The

next group is all other members (OMC) who were members of the EU previous to the 2005 enlargement – Portugal, Sweden, Denmark, Belgium, Luxembourg, Ireland, Austria, Finland, and Greece. The new members (NMC) group includes those new members from 2005 and on – the Czech Republic, Poland, Latvia, Lithuania, Slovakia, Slovenia, Malta, Cyprus, Romania, Bulgaria, Hungary, and Estonia. The rest-of-world group is treated as a single group, with intra-ROW trade eliminated. In a similar fashion, the data for the trade from one member of a group to another member of the same group is also excluded. For example, trade between Germany and France is not included, but trade between Germany and Poland is included in the analysis.

The analysis with the data aggregated into these country groups is performed for several reasons, but also comes with a few drawbacks. The potential benefits and drawbacks of this aspect of the analysis depend on whether the effects of enlargement show up in the bilateral trade between countries in the same group or in different groups. The country group analysis will be effective in showing the role of trade displacement if the majority of the displacement occurs between countries in the LMC and the OMC groups. If the enlargement of the EU caused reduced exports between one member in LMC and another member in OMC, then the following analysis by country groups will show these effects. In fact, with the intra-group trade eliminated, only this trade displacement between groups will be presented in the analysis, and the magnitudes of these effects could therefore be overstated. However, as magnitudes of the effects are of less importance to the analysis than the existence of these effects, this overestimation is tolerable. The country group analysis will help offer insight into the hypothesis that the enlargement of the EU causes trade

displacement away from the current members, i.e. the new members become the sources for exports for a country at the expense of the other members outside of its country group.

The most important drawback of performing the analysis by country group arises if the majority of trade displacement caused by enlargement occurs between countries in the same groups. If countries in either the LMC or OMC groups replace trade with other members of the same group with exports from the NMC, then these effects will not show up in the analysis. For this reason, the analysis is performed by individual countries after the analysis by country groups.

Figure 2.1 - Nominal Total Trade

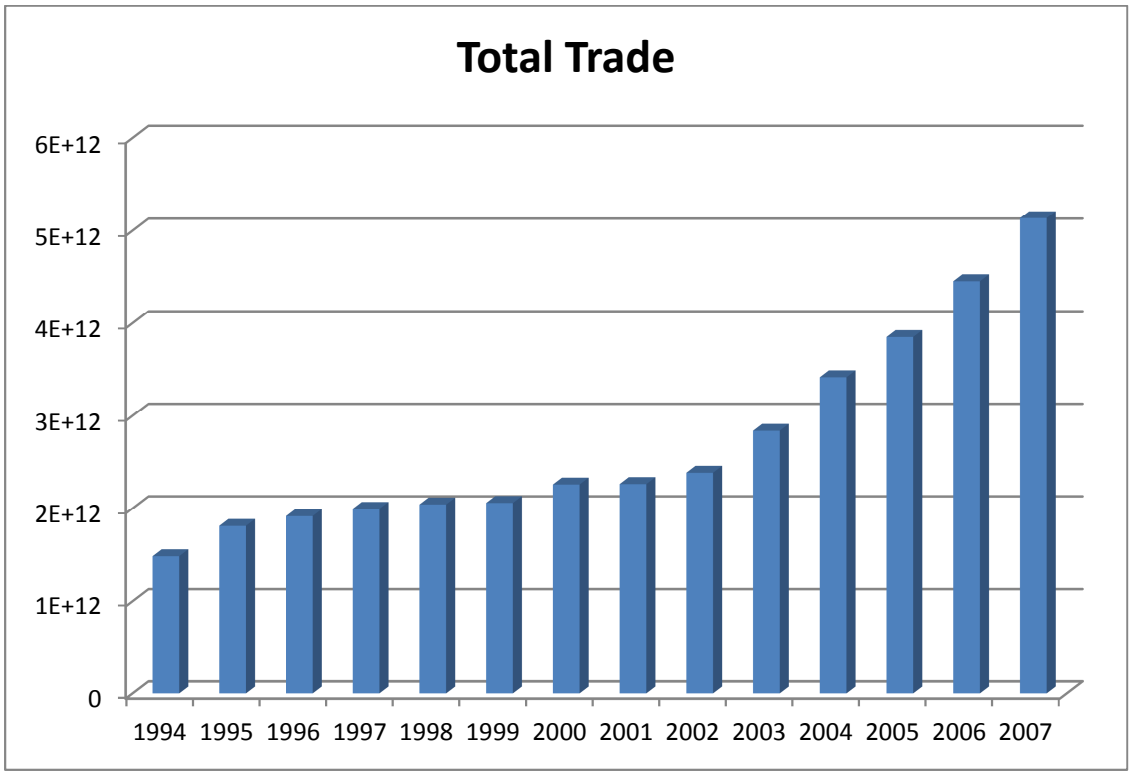
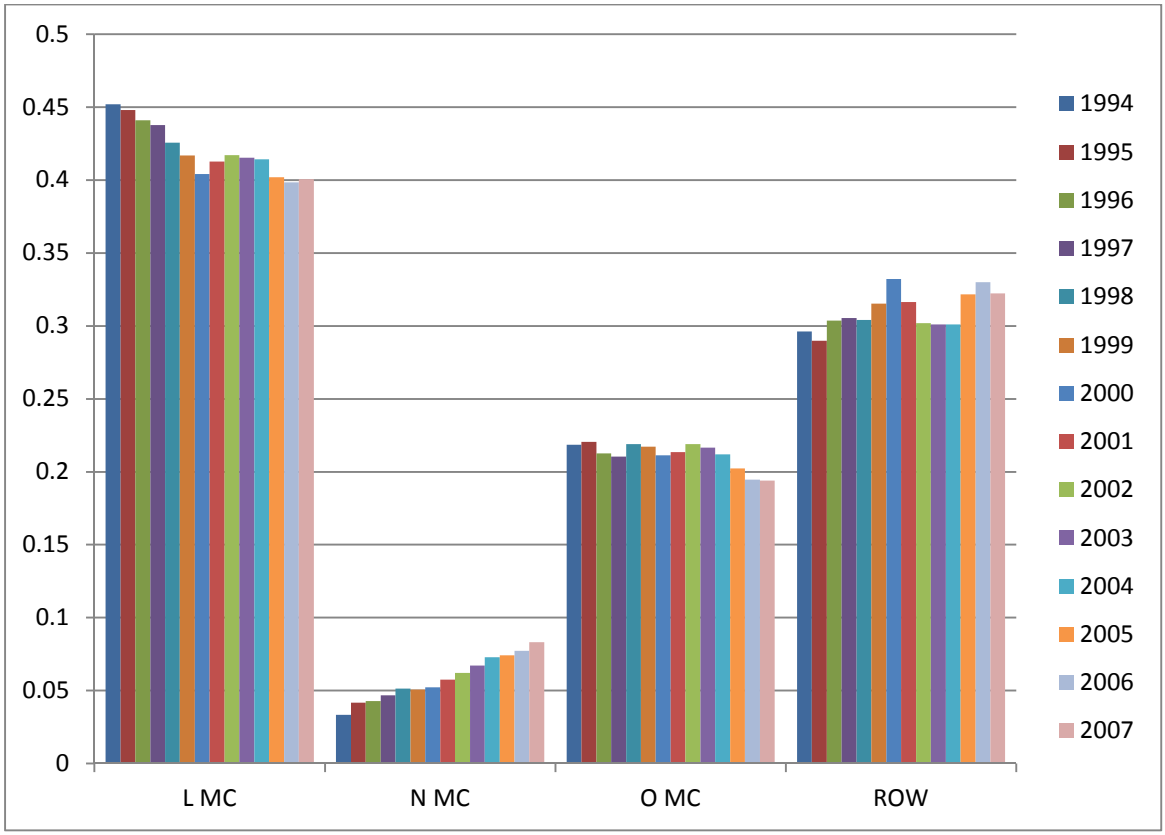


Figure 2.2 - Share of Total Trade by Country Groups



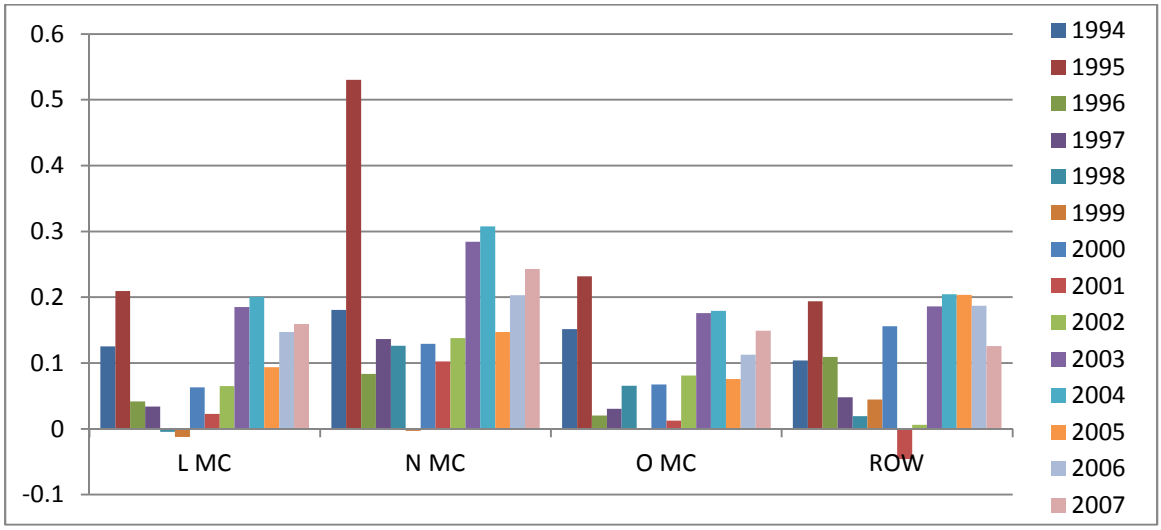
The share of exports of each country group is displayed in Figure 2.2. A glance at the figure reveals some fairly clear trends. The large member countries (LMC) began the sample in 1994 with approximately 45% of the total $1.48 trillion of exports into (or out of to ROW) of the European Union. The group finished the sample in 2007 with approximately 40% of the value of exports (of the $5.13 trillion). The share of the other member countries' (OMC) exports had more periods of increases, although the trade share decreased every year after 2002, and overall declined from just below 22% to 19.4%. On the other hand, the new member countries exhibited an increase in share of trade in every year in the sample except in 1999, although the value only decreased slightly. Overall, the share of exports from that group increased from 3.34% in 1994 to 8.83% in 2007. Exports from the rest of the world

(ROW) to the other three groups accounted for 29.6% of the trade in 1994, meaning that almost 30% of the non-EU countries' trade was destined for Europe. The value generally increased to a peak of 33.2% in 2000 before falling and then increasing again to 33.2% in 2007.

A very cursory analysis of these figures would suggest that the exports of the new members, and the ROW to a lesser extent, are increasing at a faster rate than that of the large members or other members. This would suggest that trade displacement could be a significant factor in European trade over the past fifteen years. However, the data must be further examined before any conclusions can be made.

Rather than looking at the share of European trade the various country groups account for, the group's growth in trade is another value that can provide insight into the presence of trade creation, diversion, and displacement. These values are displayed in Figure 2.3.

Figure 2.3 – Percentage growth in trade

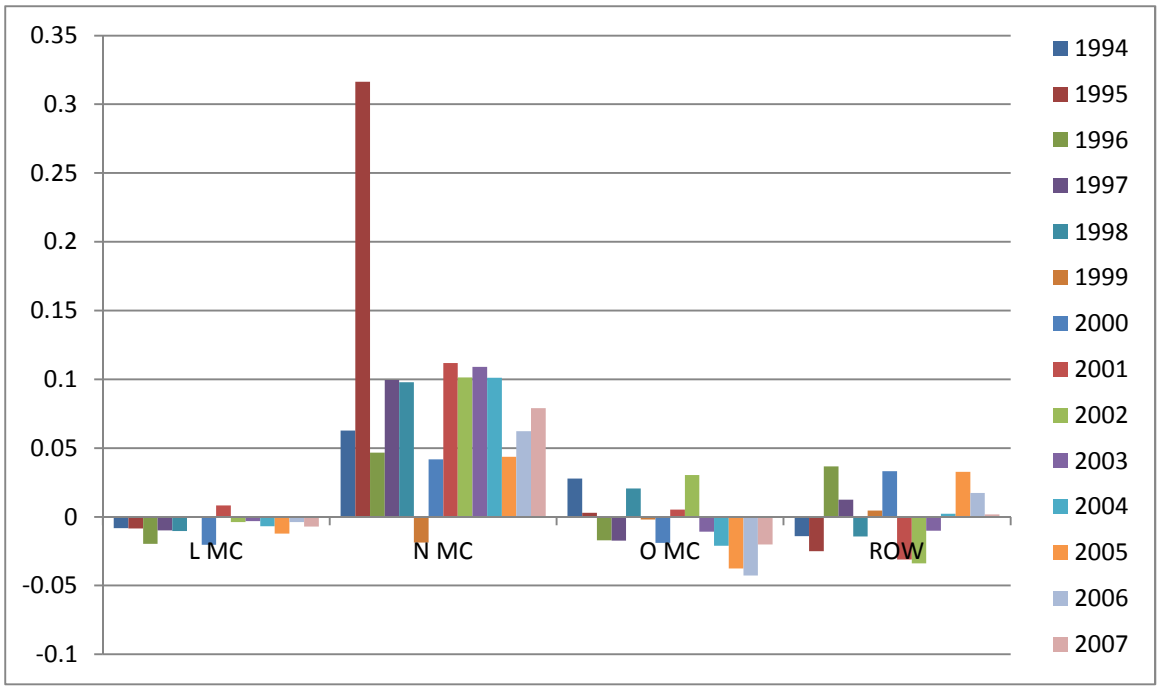


The variation in growth of trade, in terms of percentage growth, appears to be much greater and exhibits less of a trend than the portion of European trade. However, the increase in trade growth originating from the new member countries is greater than the trade growth of

the other European country groups in every year, and nearly every year compared to the ROW.

A breakdown of the individual effects, particularly the competitiveness effect, will help illustrate the presence of the various trade effects. These effects can be presented in nominal values, proportion of European trade, or trade growth percents. The latter is perhaps the best at illustrating the difference in the competitiveness effects, which, as described above, is a measure of the unexplained growth in exports after accounting for normal growth, market destination, and commodity composition.

Figure 2.4 – Competitiveness Effect



The competitiveness effects exhibited in Figure 2.4 display the extremely large differences in unexplained growth in trade from the new members compared with the three other groups. In fact, after accounting for the normal or average growth, the market, and the commodity effects, the growth of the large member countries' trade is actually negative for all but 2001,

although small in magnitude (the largest change is 2000's -2.0% growth). For the large member countries, the average over the entire sample is -.75%. The countries in the other member countries grouping also have several years with negative values for the competitiveness effect. In several years, the magnitude of the growth, in terms of percentage change, is greater than that of the large member countries, and it also shows fairly significant negative values from 2003 until the end of the sample. The competitiveness effects for the ROW oscillates from positive to negative values with magnitudes similar to that of the other member countries. The new member countries, in all but 1999, show large positive values for the competiveness effect, suggesting that exports from those countries increased significantly after accounting for normal growth, destination markets, and composition of exports. Over the entire sample, the new member countries averaged an annual growth rate of 8.9%, meaning the exports from the new members have more than tripled due to the competitiveness effect.

Table 2.3 - Percentage growths from 1993-5 average to 2004-6 average

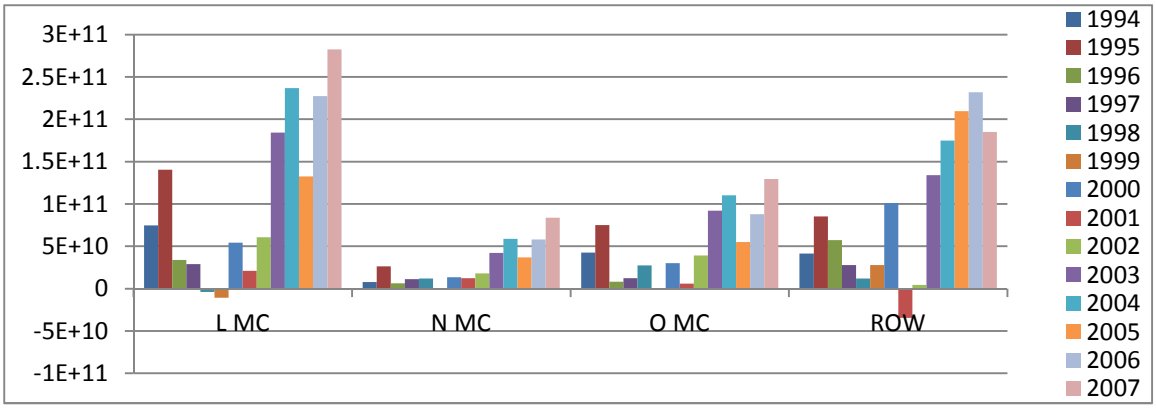
Group	Total Growth	Average Growth	Commodity Effect	Market Effect	Competitiveness Effect
L MC	159.2%	218.4%	-5.65%	-29.62%	-23.95%
N MC	532.3%	178.9%	-4.26%	-2.17%	359.84%
O MC	163.09%	199.80%	11.95%	-1.84%	-22.92%
ROW	220.79%	179.66%	11.47%	20.42%	9.24%

Table 2.3 shows the results from a static analysis using the endpoints of the sample. These results from the static approach demonstrate how significant the competitiveness effect is for the new member countries when compared to the other effects of the other groups. The commodity effects are relatively small for all four groups, but the positive values for the OMC and ROW groups suggest that exports from those countries have exported more goods for which demand is growing at a faster rate than average. The market effect for the large

member countries is nearly -30%, meaning that those countries have experienced 30% fewer exports as a result of their destination markets growing at slower rates than average. This might also suggest that the large member countries have been slow to take advantage of the faster growing markets of Europe. However, another explanation of this negative effect is that the LMC group trades with the ROW more than the other two groups, with the ROW growing at a slower rate than the OMC or NMC countries. The ROW experienced an opposite effect, a 20% increase, suggesting that the ROW has taken advantage of the faster growing markets in Europe.

Throughout the discussion above, the analysis has been centered on the percentage growth in trade of exports. It should be noted, however, that a 10% increase in exports from the large member countries would not be equivalent to a 10% increase in exports from the new member countries, as the bases for growth are vastly different. The nominal growth in exports from the four groups is shown in Figure 2.5.

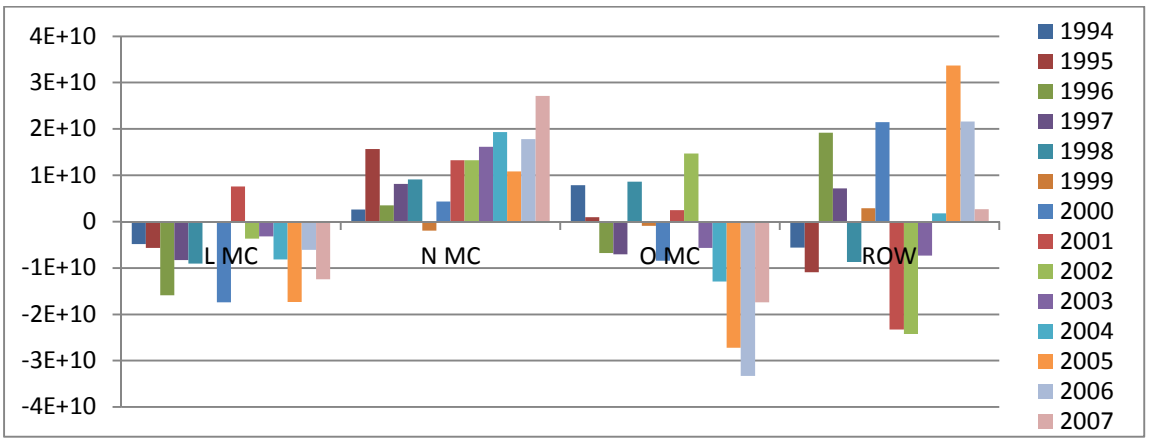
Figure 2.5 – Nominal Growth in Exports



One can see that the nominal values of the growth in trade are greater for the LMC, OMC, and ROW groups than the NMC group. However, much of this growth can be accounted for in the average or normal growth, the commodity effect, and the market effect. As shown in Figure 2.6, once those are stripped away and only the competitiveness effects

remain, the nominal growth (or reduction) in trade from the various groups are similar in magnitude, though in a markedly different in direction.

Figure 2.6 – Nominal Values of Competitiveness Effect



Recalling the intention of the shift-share analysis performed on the exports of countries of the EU while separated into country groups is to attempt to establish the existence of the three trade effects, the results appear to shed some light. While trade creation is usually assumed to exist with the reduction in trade barriers, trade diversion and, to an even lesser extent, trade displacement – one member country's exports crowded out by a new member – are not as readily accepted. However, the data above does suggest that the new members have increased their exports to the EU, and those increases appear to be at the expense of exports from the previous members. With those results, there is a need to progress further into the question of existence and significance of the trade effects. In the next section, the countries will no longer be aggregated into country groups, and the analysis will be performed with data from the individual countries.

As mentioned in the introduction, the net welfare changes of enlargement of the EU for the individual countries or the groups entail much more than just these trade effects, though they are certainly a piece of the overall effects. Increased trade between the new

members and the current members might imply a positive welfare effect, though there are more factors that enter into the net welfare effects overall. Likewise, decreased trade (as a result of trade displacement) from some members might imply a negative welfare effect, though there might yet still be an overall positive effect of welcoming the new members caused by effects not included in this analysis.[28]

V. Analysis by Individual Countries

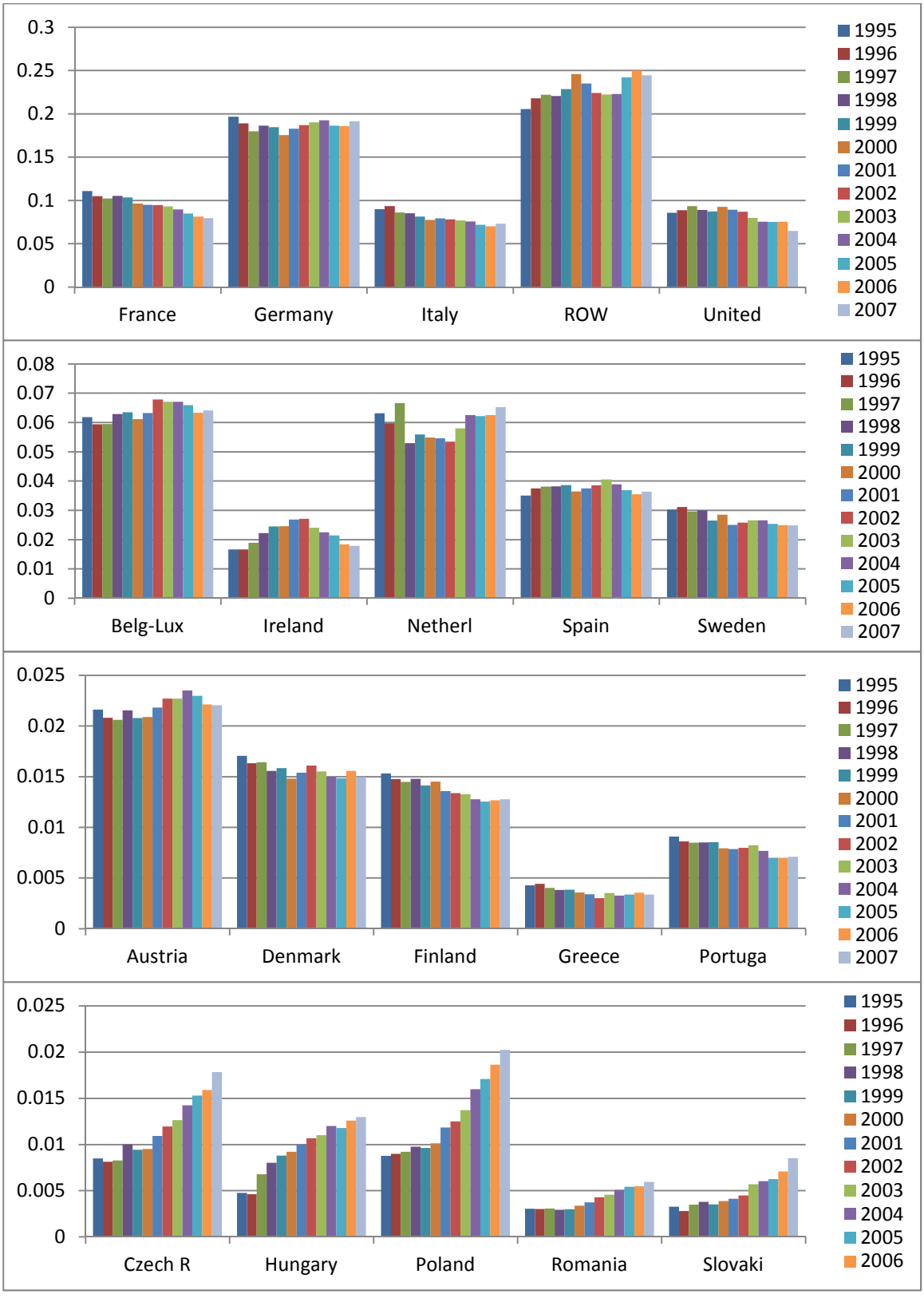
A shift-share analysis of the exports from the individual countries is also performed, and is necessary to try to alleviate the potential drawbacks of aggregation discussed earlier. Trade displacement that occurs with the enlargement of the EU that is between countries from the same group would not have become evident in the previous analysis. By examining the individual countries, reductions in exports from members – regardless of whether they are destined for similar members or other – that coincide with increases in exports from the new members will be evident in the following analysis.

The analysis will begin with the examination of the share of European exports to one another and the ROW attributed to the various individual countries, which are presented in the following graphs (please note the scale of the graphs are different). The graphs are split into groups of five depending on the share of European exports. The members of the EU-15 are presented in the first three charts along with the ROW.

As evidenced by the first chart, the ROW has increased its share of all exports destined for the EU from slightly above 20% to just below 25%. Germany, which is easily the largest individual exporter in Europe, experienced a decline in trade share before recovering to nearly the same level by the end of the sample with a value of over 19%. The

[28] For example, see Motta and Norman (2006) or MacDermott (2006) for discussion of investment flows and regional integration.

Figure 2.7 - Share of EU Exports



other three countries in the first chart experience a loss in the share of exports: France's share drops from 11.1% to 7.95%, Italy's share falls from 8.99% to 7.30%, and the UK's share drops from 8.57% to 6.49%.

The next set of countries is presented in the second set of graphs of Figure 2.7. Belgium-Luxembourg, Spain and Ireland each show a general increase early in the sample before a period of falling market share in the final years of the sample. The Netherlands experienced the opposite trend – a falling share of exports followed by an increasing share. All four countries ended the sample with a slightly higher share of exports than in 1995. Sweden, much like France, Italy, and the UK, experienced a decrease in market share for much of the sample, falling from 3.02% to 2.48%.

The smallest members of the EU 15, in terms of European export share, are present in the next set of graphs. Austria experiences a trend similar to that of Belgium-Luxembourg, Spain and Ireland, as its export share increases early in the sample before falling near the end, but finishing the sample with a slight increase overall. The smallest four members of the EU 15, Denmark, Portugal, Finland, and Greece, face falling shares of exports nearly throughout the sample. Greece, however, does show some increases in export share in the latter years of the sample.

The largest five countries of the new members are presented in the next set of graphs. The trend for these countries is a rather clear increase in share of European exports throughout the sample. More specifically, several show slow growth, and perhaps a slightly falling trade share, in the early years of the sample followed by several years of relatively large increases. Overall, Poland, the Czech Republic, Hungary, and Slovakia all more than

doubled their shares of European exports through the sample, and Romania fell just short of that. Poland's share grew from 0.877% to 2.02%, the Czech Republic share increased from 0.848% to 1.78%, Hungary's increased from .477% to 1.30%, Slovakia's share grew from 0.328% to 0.853%, and Romania's share increased from 0.306% to 0.594%.

Table 2.4 divides all of the countries in the sample into categories depending on the trend in their share of European exports. Further analysis will follow, but these initial groupings are determined with merely a look at the graphs presented above.

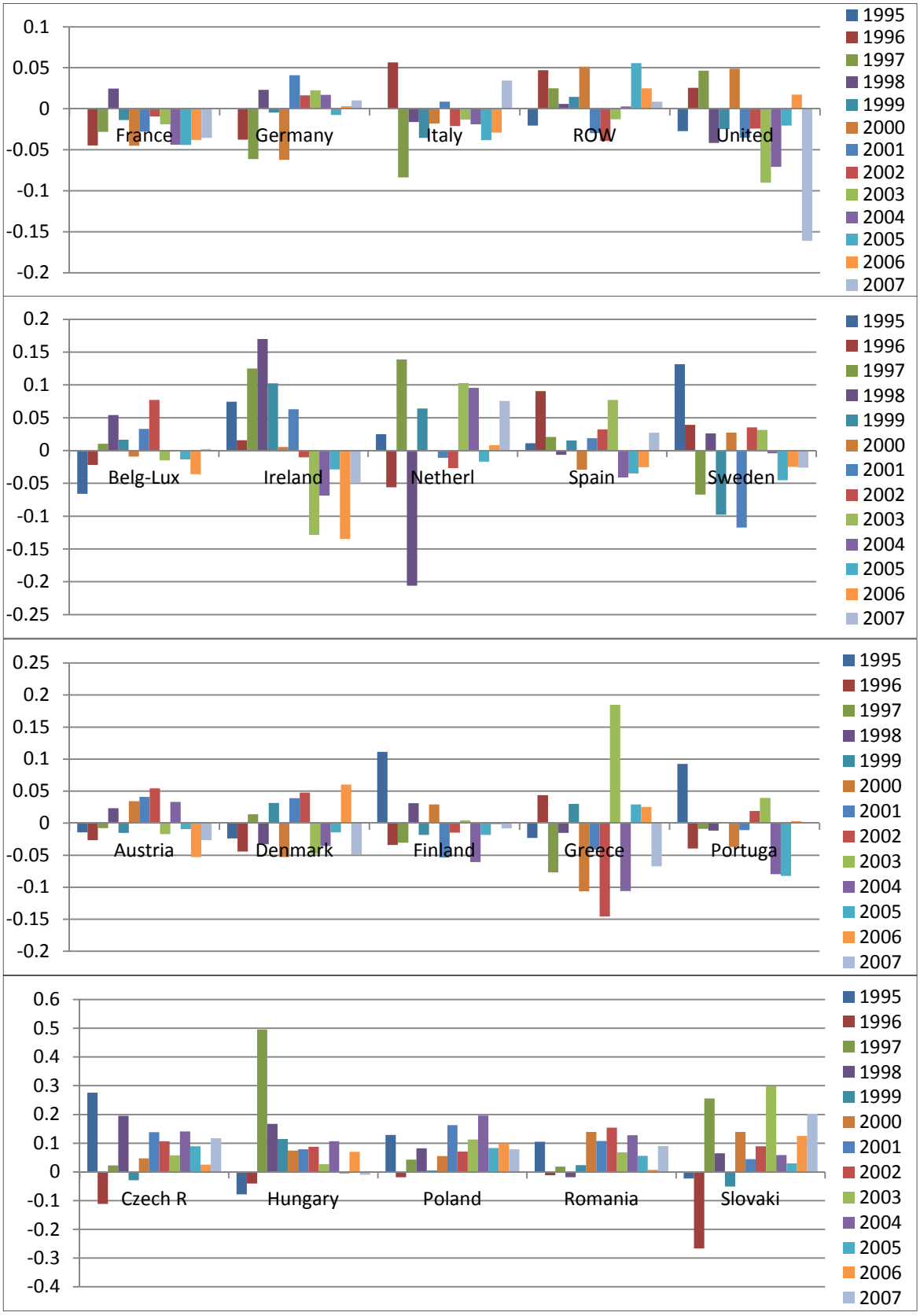
Table 2.4 – Trends in share of European exports

Trend	Countries
Decreasing	France, Italy, UK, Sweden, Denmark, Finland, Portugal, Cyprus, Malta
Decreasing, then increasing	Germany, Netherlands, Greece, Slovenia, Bulgaria
Increasing, then decreasing	Belgium-Luxembourg, Spain, Ireland, Austria
Increasing	Poland, Czech Republic, Hungary, Slovakia, Romania, Estonia, Latvia, Lithuania

Analysis of the trade shares allows for a glimpse into the trends in trade throughout the sample. However, examination of the nominal values and the percentage growth values will help get further into the existence and significance of the various trade effects, namely the trade creation, trade diversion, and trade displacement. In addition, examination of the competitiveness or unexplained growth effects will pare away average growth, market, and composition effects so that these factors do not influence the export growth throughout the sample.

The following set of graphs in Figure 2.8 shows the competitiveness effects in terms of growth percents for the countries in the sample:

Figure 2.8 - Competiveness Effects, by growth rate



As expected, the competitiveness effects are much more erratic than the trends in the trade shares. For the most part, however, the values of the competitiveness effects mirror those trends presented above. Increases in trade shares appear to be correlated with positive values for competitiveness effects. For example, as displayed in the last set of graphs, the largest of the new members of the EU each show positive competitiveness values for most of the sample, with a magnitude averaging about 8% per year. Hence, after accounting for average growth, the makeup of its exports, and the destination for its exports, each of the five countries shown exhibited an average of 6%-9% growth over the entire sample. Considering that an average of approximately 7.177% growth would double the initial value over a ten year period, it is clear that the new members have made significant increases in their European exports.

Conversely, of the largest members, as shown in the first set of graphs, France, Italy, and the UK each show several years of the sample with a negative competitiveness effect in terms of growth percents. Hence, these countries are losing their market share because they are actually exporting less than previous years to the rest of Europe after accounting for average growth. Germany on the other hand, after a few years of falling exports due to the competitiveness effects, recovers with positive values for six of the final seven years of the sample. The ROW, starting in 1996, shows positive values for five years, followed by negative values for three years, and then positive values again for the final four years of the sample.

The ten other members of the EU 15 shown in the second and third sets of graphs all show much more volatile competitiveness effects over the sample period. Of note in the first set, however, are Ireland's positive values in the early part of the sample, followed by

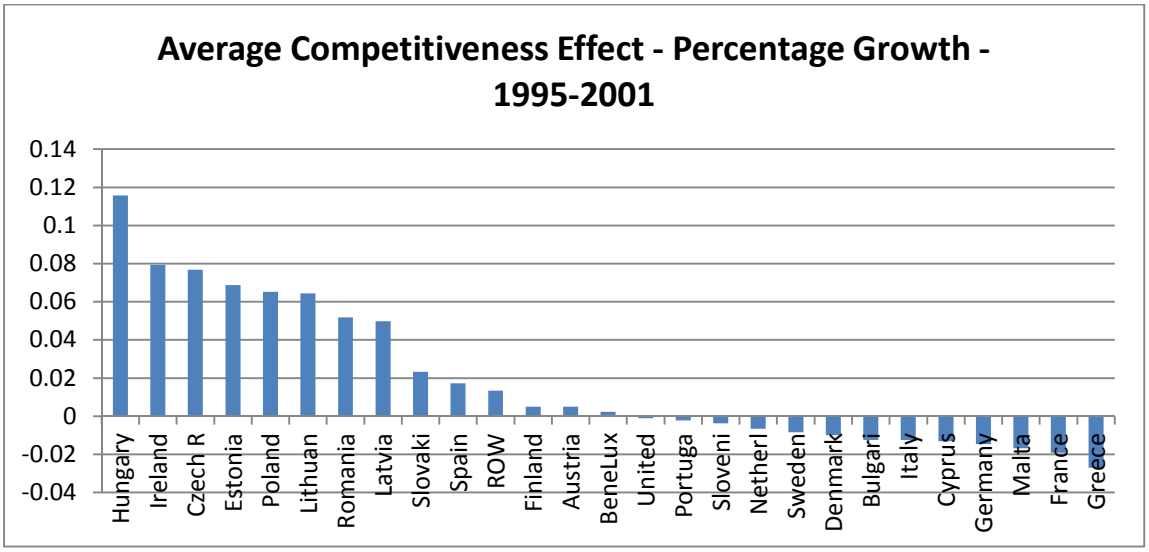
negative values in the latter years. In fact, of the five countries, Ireland, Belgium-Luxembourg, and Sweden all have negative competitiveness effects in at least four of the last five years in the sample, and Spain has negative values in three of the years since 2003. The Netherlands, conversely, shows positive competitiveness effects in four of the last five years of the sample.

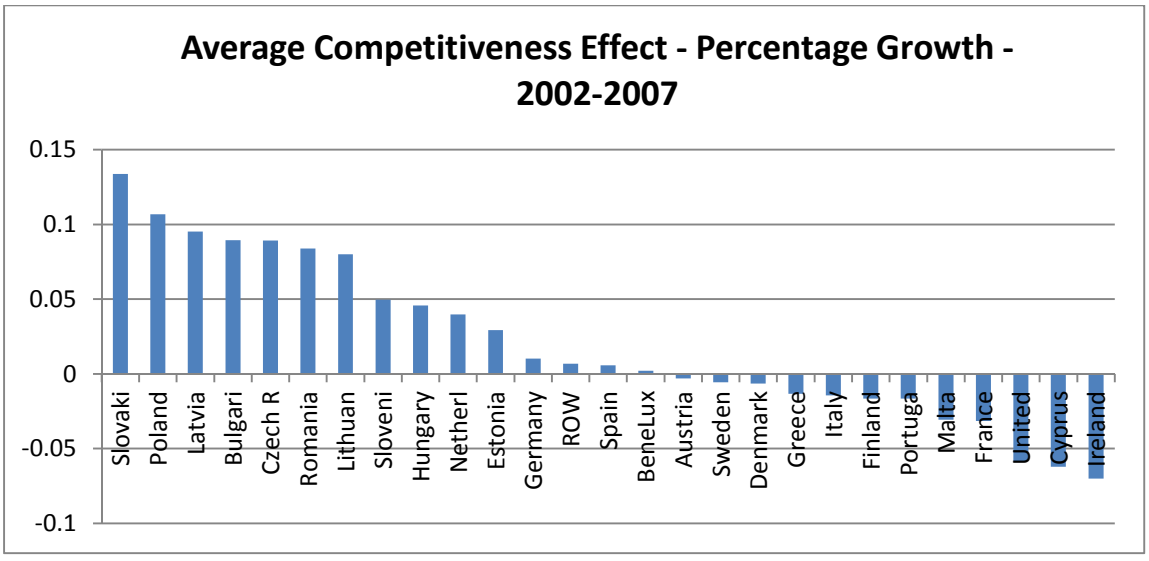
The smallest of the EU 15 members, shown in the third set of graphs, appear to show very little or no trend in competitiveness effects over the sample. Once again, though, Austria, Denmark, and Finland all show negative values in four of the years since 2003. Greece and Portugal only exhibit negative competitiveness effects in two of those years. However, in Portugal's case, those negative competiveness effect values in 2004 and 2005 imply an approximate 8% decrease in exports in each of those years, compared to 0.346% and 0.0359% increases in exports in 2006 and 2007, respectively.

The positive and negative competitiveness effects, as reported in terms of percentage growths, are difficult to compare. For example, Poland showed the largest average increase in trade over the sample at 8.44% per year while the UK exhibited an average of 2.75% decrease in exports per year due to the competitiveness effect. These values allow for insight due to the sign of the value, but because the countries' values of trade vary so much at the beginning of the sample, the nominal values must also be examined.

The main goal of examining the nominal values of the competitiveness effect is to infer whether the gains in trade values from one or more countries comes as a loss in trade values in other countries. Among the large members shown in the first set of graphs, the competitiveness effects of France's exports are profound. Over the sample, after accounting for average growth of exports and the growth due to composition and destination markets,

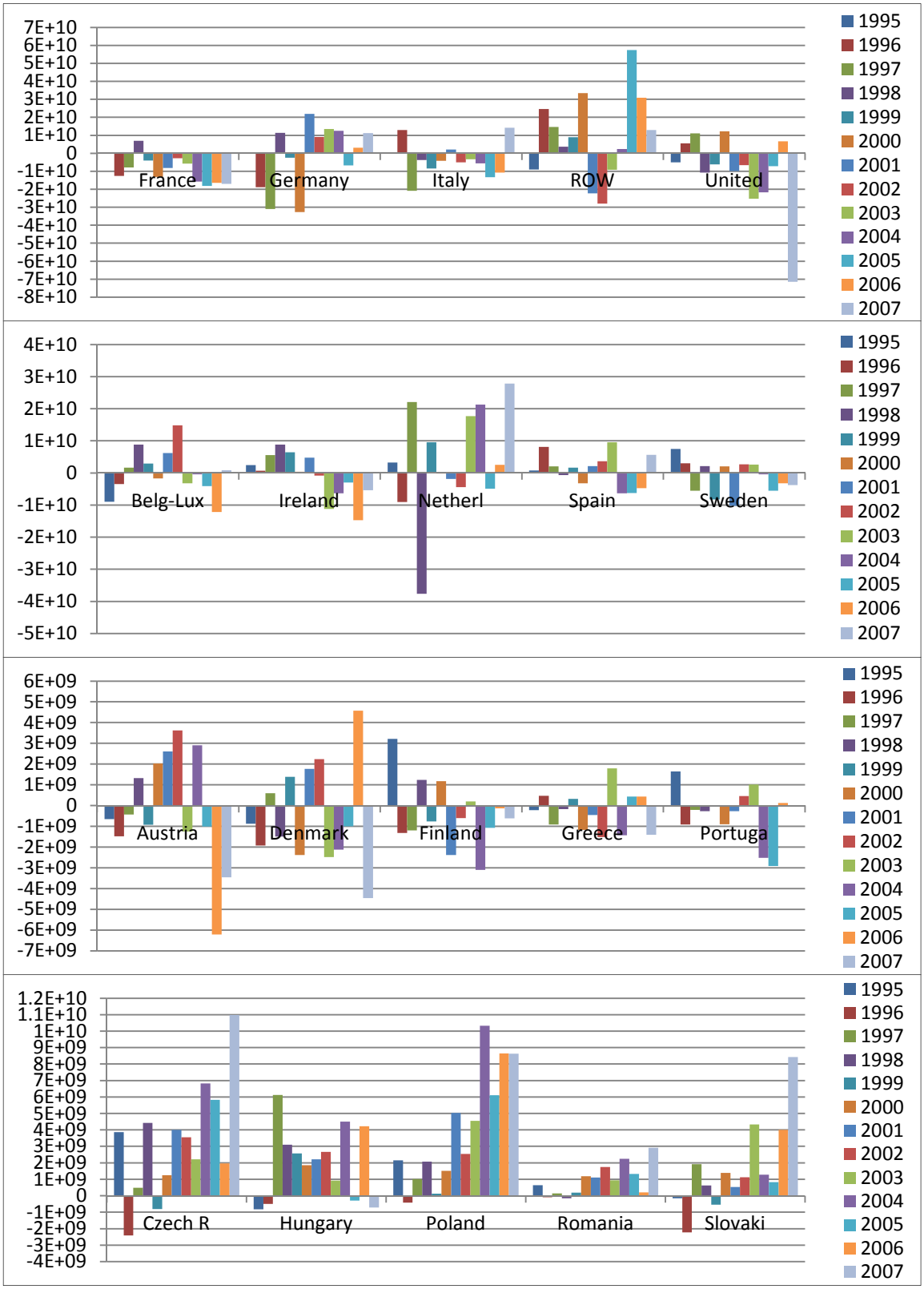
Figure 2.9 - Average Annual Competitiveness Effect, by growth rate





France *averaged* a reduction in trade by nearly $9 B *per year*, equivalent to almost $115 B over the course of the sample. Furthermore, in the final five years of the sample, 2003 through 2007, France averaged a loss of $14.6 B per year and a total of more than $73 B. Italy and the United Kingdom experience similar effects. For Italy, the competitiveness effect averages -$3.53 B per year for a total of -$45.9 B. The United Kingdom experiences a negative competitiveness effect that averaged $9.89 B per year and totaled -$120 B over the sample period. However, these two countries' values are affected by differing results for

Figure 2.10 – Nominal values of competitiveness effects



2007, when Italy exhibited a positive competitiveness effect of $14 B while the UK experienced its largest loss – an astounding $71 B reduction of exports due to the competitiveness effect.

As above, the mid-size and smaller members presented in the second and third sets of graphs exhibit competitiveness effects that show several years of positive and negative values. Belgium-Luxembourg, Spain, Sweden, and Ireland each have periods of growth before finishing the sample with at least three years of negative growth among the last five, including 2006 when Belgium-Luxembourg and Ireland lost more than $10B worth of trade. There are similar trends in the smaller country group, though the magnitude of the trade growth and losses is smaller (note the difference in the scale). The new members in the chart show growth in the value of trade in most years in the sample, and those positive values appear to be increasing in magnitude. Compared to France's loss of $14.6 B worth of trade per year over 2003 to 2007, Poland averaged increases of $7.7 B, the Czech Republic averaged increases of $5.5 B, and Slovakia averaged increases of $3.8 B. In 2007 alone, in the final year of the sample after accounting for average, market, and composition effects, these three nations combined for an increase in $28 B worth of trade – $11.0 B for the Czech Republic, $8.6 B for Poland, and $8.4 B for Slovakia.

Discussion of the implications that these trade effects have on country welfare is not a goal of this paper, though it is somewhat difficult to ignore. It does seem, however, that the positive values of the competitiveness effects for the new members would have a positive welfare effect on the country as a whole. This would be just one factor in the net welfare change in the countries due to EU enlargement. Conversely, it might seem as though the negative values, as for France, for example, would imply a negative welfare effect. While

the unexplained decrease in exports might have a negative effect, there are many other avenues in which EU enlargement has an effect on overall welfare of the country. Hence, while the trade effects may be negative, it is impossible to make general statements about the overall welfare effects of enlargement.

While the changes in patterns of the exports of the European countries have been demonstrated in the graphs above, the implication for the reasons for these changes has remained that the run-up and accession to the EU has been largely responsible. However, it is important to note that individual countries have experienced different situations, and various policy effects may be driving some of the changes in export performance. One such example is Germany, which showed signs of decreased export performance early in the sample followed by a recovery of market share and positive competitiveness effects later in the sample. Prior to the sample used, the reunification of East and West Germany had major implications on the German economy. Michael Burda and Jennifer Hunt (2001) provide a fairly exhaustive demonstration of the changes in the labor markets – wages, productivity, and migration – in post-unification Germany, as does Snower and Merkl (2006) and Burda (2006). Hans-Werner Sinn (1996) addressed the devaluation of other currencies as a result of German unification. All of these 'unification shocks' are surely felt well into the sample and could contribute to the changes in German export patterns. As Sinn (2000) indicates, however, much of the adjustments, particularly the wage and productivity gaps between West and East, seemed to have become fairly stable by the mid-1990's, creating the question of the implications of post-unification adjustments on German exports around the turn of the century.

Germany is certainly not the only country to undergo changes prior to the run-up to enlargement. In fact, many of the 2004 accession countries experienced various socio-economic transformations over the past decades, and determining the effects of these structural changes apart from preparation for integration is a difficult task. In an examination of the effects of integration on Slovakia, Vagac et al. (2001) concede this point: "It is extremely difficult or impossible to separate the effects of EU integration from other components of the process [of transformation] . . . It is also difficult to differentiate between the gains and losses arising from the various stages of relations with the EU."[29]

As a result of these various individual country circumstances that might affect trade patterns, caution in making sweeping interpretations of the results of the shift-share analysis need to be taken. But caution with interpretations is also not unique to this analysis, and one could also argue, particularly in the case of the new members (but not in the case of Germany), that the transition in the economies was in large part due to the prospect of accession into the EU, and therefore part of the larger integration process. While the shift-share analysis above has focused on the liberalization of trade between the EU countries and new members, we can conclude that this liberalization over the sample period is one (significant) part of the enlargement process.

VI. Policy Implications

The shift-share analysis performed above shows that, in terms of the value of trade, the new members of the EU have increased exports in recent years at a rate much greater than the average of EU countries. On the other hand, both the groups of the large member countries and the other members before the unprecedented enlargement in 2004, have increased exports at a rate below that of the average. In addition, the increases in exports

[29]Vagac et al. (2001), page 21.

from the new members are increasing through the sample. While negative growth from the competitiveness effect – or positive growth below average – is fairly consistent for the large members as a group, the other members of the EU show significant negative competitiveness effects in the latter portion of the sample.

As individual countries, the results are consistent with the group results. However, France and the U.K., and Italy to some extent, have carried the losses of the large countries, while Germany has maintained its position as the dominant exporter of the EU. Additionally, most of the other members of the EU outside of the largest countries have also shown decreases in exports after accounting for average growths. Combined with the increases in exports from the new members at well above average rates, these results suggest that the new members' exports are an increasing source of competition for EU members' exports.

The policy implications of these results are that the enlargement of the customs union may not be a welcome thing to all current members of the EU. While this analysis is admittedly only examining the trade aspect of enlargement, the results show that the exports from new members of the EU have essentially crowded out the exports of many of the current members. This, however, is not universal, as evidenced by the performance of Germany in the sample. The implication of this is that, while it benefits a nation a great deal to be a member of the EU in terms of export performance, it is also beneficial to many to not allow other nations to become part of the union. This is the case for many members, including some of the largest and most influential members such as France and the U.K., but also smaller members such as Ireland and Portugal. Overall, on the basis of trade performance, the results of this analysis suggest pro-enlargement policies for those outside of the union, but anti-enlargement policies for many members once they become part of the

union. For example, while many of the eastern European countries have worked diligently and campaigned for EU enlargement over the past decade so they could be included, this analysis suggests that, since they are now members, they should change to an anti-enlargement stance when presented with possible future enlargements.

VII. Conclusions

One of the main goals of this analysis is to establish the existence of the three different trade effects discussed earlier in the paper – trade creation, trade diversion, and trade displacement. The three effects and their expected results are presented in Table 2.5 below.

Table 2.5 – Expected results of trade effects

Effect	Expected result
Trade Creation	Increased exports from new to current members; increased exports from current to new members
Trade Diversion	Increased exports from new to current members; decreased exports from ROW to current members
Trade Displacement	Increased exports from new to current members; decreased exports from some current to other current members

The results of the shift-share analysis, which attempts to strip away the effects due to average growth of trade and changes in trade due to market and composition effects, show that the effects of trade displacement are potentially large. Increased exports from the new members to the current members – both large and other members – is demonstrated by the results of the data. However, this is expected in each of the three trade effects. Increased trade from the new members to other members most likely resulted from trade creation. The lack of the expected increase in exports at even average growth rates from the current members to the new members actually suggests that the magnitude of trade displacement may be understated, given that some trade creation did occur. In fact, access to the new member markets, and thus where trade creation would be most significant, is a key to Germany's ability to recover and maintain its share of exports. The share of Germany's

European exports destined to the new members rose from about 8% to about 13% over the sample, while only Italy's share of European exports topped 6% of all the other nations (other than the new members themselves).

The discussion of trade diversion is one that is inconclusive, mainly because the results for the ROW are rather erratic. There is a period from 2001-2003 where there is a decrease in the export value originating in the ROW destined for the EU, which suggests that trade diversion may have been taking place during that time. While many of the new members do show positive values for the competitiveness effect during this time, several others do as well. The competitiveness values for France, while still negative, are much less than in the subsequent years, and Belgium-Luxembourg, Spain, Austria, and Portugal all seem to benefit from this reduction in exports from the ROW. As these countries were already current members, these results do not provide evidence of trade diversion. One possible explanation is the adjustment to the common currency during that time period. The increased trade from the ROW to the EU in the latter part of the sample can also not be explained by the trade effects.

While Germany's value of exports was able to recover in the latter portion of the sample, many other member countries exhibited decreases in export values in many years when taking the competitiveness effect into account. These decreases suggest that a significant amount of trade displacement occurred. The increases in exports from the new members have come at the expense of exports originating from other current members, both large and small, and old and more recent members. In these cases, as opposed to the German example, the added exports to the new members have not made up for the lost exports to other members. These 'lost' exports are due to the increased competition from the new

members. Countries, such as Germany, are replacing some imports from other members such as France with imports originating from Poland, the Czech Republic, or Slovakia. The negative values for the competitiveness effects show that the increased access to the new members' markets has not made up for the losses due to added competition in other export markets. Thus, for some nations, the negative effects of trade displacement caused by enlarging the EU have appeared to outweigh any positive effects of trade creation.

CHAPTER 3

Investigation of Trade Displacement Caused by the Enlargement of the EU

I. Introduction

Participation in preferential trade agreements is a common form of economic policy in today's global environment. The European Union is the largest customs union, both in terms of size, population, and volume and value of traded goods. There has been a fairly significant amount of literature dedicated to the effects of the formation of such a customs union, but little has been said about the effects of enlargement of an existing customs union. This paper will estimate the significance of those effects in terms of the trade displacement effects caused by the enlargement of the EU.

Since Jacob Viner first used the terms 'trade creation' and 'trade diversion' in 1950[30], they have become staples of trade agreement literature. Viner's trade creation was based on increases in welfare caused by the shifting of production from a high-cost producer to a low-cost producer as a result in changing trade policy, namely the reduction of trade barriers. Trade diversion involved production of goods relocating from a low-cost producer to a high-cost producer, a result that could have negative welfare implications. The importance and magnitude of these effects have been discussed in regard to the formation of a customs union (or preferential trade agreement).

When a customs union expands to include new members, as the EU has done on multiple occasions, these two effects continue to exist. However, there also exists the

[30] Viner, Jacob. The Customs Union Issue.

potential for a third effect: trade displacement. Using Viner's terms, trade displacement results in a production shift from a high-cost producer to a low-cost producer, yet not in the same manner as trade creation. Trade displacement involves the movement of production from one member of the customs union to a lower-cost new member. As production costs decrease, an overall increase in welfare is expected. However, individual country welfare depends on the trade displacement. Essentially, trade displacement occurs when an existing member's exports are *displaced* by exports from a new member.

Trade displacement is, in fact, a matter of import switching, which is where this essay differs from the previous two. While those essays examined export performance amidst an enlarging customs union, this essay will use import data to identify the significance of trade displacement within an enlarging EU. In terms of trade displacement, import switching refers to substituting imports from one country (a higher cost existing member) with lower cost imports from another (a new member). An example of this within the EU would be Germany substituting imports from France with imports from Poland.

The existence and magnitude of this result is exactly what this essay will examine – the trade displacement effects of EU enlargement. Import data will be used to investigate the role of trade displacement from the largest imports in the EU with a focus on the effects on both the new member countries and the existing member countries. The next section of the paper briefly discusses the use of the gravity equation in international trade literature. Section 3 of the paper describes the data that will be used. Sections 4 through 6 discuss the model used to estimate trade values, along with the significance and magnitude of the trade displacement effects. Section 7 concludes.

II. Literature Review

The gravity model in international trade was first introduced by Tinbergen (1962) and Poyhonen (1963), and its continued use is a testament to the explanatory power it provides. While its uses within the field of international trade span a variety of topics, it has been particularly useful in estimating the effects of integration, policy effects, and membership in a supernational organization on trade flows. Rose (2004) is a leading example of this last type by measuring the effect of WTO membership on trade. Despite its clear usefulness, part of the initial criticism of the gravity model stems from the perceived lack of theoretical foundations of the model in international trade. This topic has been addressed by several notable well respected authors such as Jeffrey Frankel, James Anderson, Jeffrey Bergstrand, Alan Deardorff, Eric Van Wincoop, Elhanan Helpman, and Paul Krugman. These, authors, along with many others, have provided an evolution of theoretical foundations of the gravity model. Anderson (1979) presents an early example of the theoretical foundations of the gravity model using goods that are differentiated by country of origin along with preferences which exhibit a constant elasticity of substitution. Later extensions, including those of Bergstrand (1989) and Deardorff (1998) incorporate monopolistic competition into the theoretical foundation. Within the last decade, Eaton and Kortum (2002) have expanded the Ricardian and Dornbusch-Fischer-Samuelson models to show their compatibility with gravity estimation. Anderson and Van Wincoop (2003) have used CES demand and monopolistic competition to construct a model that demonstrates the importance of relative trade costs in bilateral trade. Bergstrand, Egger, and Larch (2011) provide an alternative framework which does not have the restriction of symmetrical trade costs as in Anderson and van Wincoop's model. Haveman and Hummels (2004) have also demonstrated with the use

of incomplete specialization and trade costs that the gravity model has theoretical foundations. In addition to the theoretical foundations built by the mentioned papers, Feenstra, Markusen and Rose (2001) have shown the effects of the different theories on the estimated parameter values.

As for estimation using the gravity model, Cheng and Wall (2005) outline estimation methods that allow for heterogeneity, noting that omitted variables can lead to estimation bias. Egger (2002), Egger and Pfaffermayr (2003), and Kandogan (2007) also discuss the use of the gravity model in the evaluation of trade blocs. Among important points from the authors are the use of imports as the dependent variable improves the overall fit of the model, multi-year average values should not be used, and inclusion of common border, common language, and monetary variables should be considered. In addition, for pooled data, Egger and Pfaffermayr (2003) and Kandogan (2007) suggest the use of bilateral, importer, exporter, and time fixed effects, with the bilateral effects reflecting uncontrolled factors such as the preferential trade agreements.

III. Data

The import data used in this essay come from the United Nations Comtrade Database. The figures are reported to the UN by individual countries and are listed in terms of the value of trade in U.S. dollars. The import values for the largest EU economies (Germany, France, Italy, the Netherlands, Spain, and the United Kingdom) from each of the other EU countries and twelve other nations are used in the estimation process. This data is available for most countries throughout the sample, the time period from 1994 through 2008, with a few exceptions. Other data come from the Eurostat database and the World Bank, and distances are reported by indo.com. Per capita GDP is reported in constant 2000 U.S. dollars.

IV. Model

Trade displacement is reflected in deviation from an expected value of trade due to certain country characteristics, in this case, being a new member to the EU, or an older member. The gravity model has been widely used in trade literature to estimate bilateral trade between countries.[31] The basic model suggests that the value of trade between two countries is dependent on the masses of the two countries, i.e. the sizes of their economies, and the distance between them, given by the basic equation

(1)

$$T_t^{ie} = C \cdot \frac{{M_t^i}^{\beta_1} \cdot {M_t^e}^{\beta_2}}{{Dist_{ie}}^{\beta_3}}$$

where C is a constant, T is trade value in either exports or imports (or the sum), M is mass or any variable representing country size and/or endowments, and Dist is the distance between countries i (importer) and e (exporter) at time t. Changing to the terms used for these purposes, and including binary variables that represent the inclusion to a particular group of countries or year, we have

(2)

$$M_t^{ie} = C \cdot \frac{({GDPPC_t^i}^{\beta_1} * {POP_t^i}^{\beta_2}) \cdot ({GDPPC_t^e}^{\beta_3} * {POP_t^e}^{\beta_4})}{{Dist_{ie}}^{-\beta_5}} \cdot \prod_{g_e=0}^{3} \prod_{p_t=0}^{4} e^{\gamma_{g_e,p_t} D_{g_e} D_{p_t}}$$

where the value of imports, M_t^{ie} , to country *i* from country *e* at time *t* is estimated by a constant C, the per capita GDPs (in constant 2000 U.S. dollars) of countries *i* and *e*($GDPPC_t^i$and $GDPPC_t^e$) , the populations of countries *i* and *e* (POP_t^iandPOP_t^e), the distance between the capitals of country *i* and country *e* ($Dist_{ie}$), as well as a factor influenced by

[31] See Frankel (1997) for discussion on theoretical foundations of the gravity model.

which country group the exporter is in and the year. Taking the natural logarithm of the equation results in the equation to be estimated:[32]

(3)

$$lnM_t^{ie} = lnC + \beta_1 lnGDPPC_t^i + \beta_2 lnPOP_t^i + \beta_3 lnGDPPC_t^e + \beta_4 lnPOP_t^e + \beta_5 lnDIST^{ie} + \sum_{g_e=0}^{3} \sum_{p_t=0}^{4} \gamma_{g_e,p_t} D_{g_e} D_{p_t} + \varepsilon_t^{ie}$$

where *i* is the importing country, *e* is the exporting county, *t* is the time period, $p_t$is the year grouping, and g_e is the exporter's country group. $D_{g_e}$and D_{p_t} are dummy variables for country group and time period[33]. The country groups are the new members in 2004 (D_{g_1}), the core members (the same as the importers selected) (D_{g_2}), and the other members (D_{g_3}). The ROW (D_{g_0}) group will be omitted and serve as the benchmark group. The time period dummy variables will be the 1997-1999 period (D_{p_1}), 2000-2002 (D_{p_2}), 2003-2005 (D_{p_3}), and the 2006-2008 (D_{p_4}) periods. The 1994-1996 period (D_{p_0}) will be the benchmark.

The coefficients would be expected to be positive for the respective GDPPC and POP variables, as larger, wealthier economies both import more goods and export more goods. Similarly, the coefficient of the DIST variable is expected to be negative (written in this form) as countries would be expected to import more from those countries that are geographically closer. The coefficients on the binary variables for country groups will help determine the significance, if any, of trade displacement in the expanded EU.

[32] See the appendix for the expanded version of the estimated equation.

[33] With the estimated equation written in this form, $D_{g_0}$and D_{p_0} are both equivalent to 1. This allows for inclusion of the non-interacted dummy variables. That is, both $D_{g_e}$and $D_{p_t}$are included independently in the analysis along with the interaction terms. See the expanded equation in appendix 2 for more clarity.

The magnitudes of the estimated coefficients are expected to be informative, but interpreting these must be done with caution, given the way that the data has been chosen. With only the top 12 exporters from the ROW selected in the data, the trade from the ROW groups will appear very strong, possibly stronger than the exports originating from the other EU countries. However, the changes in the values for the γ's from one time period to another will be the points of interest. For one particular country group, increases (decreases) in gamma through the three time periods would suggest that imports to the large EU economies from this group have increased (decreased). In particular, trade displacement would be represented by increasing γ's for the new member group *and* decreasing γ's for the other member or core groups. Displacement might also occur with increasing γ's for the new member group at faster rates than increasing γ's for the other member or core groups.

The estimated equation (3) is similar to the equations in the literature to test the significance and effect of membership to an organization or institution, such as the WTO in the case of Rose (2004) or the EMU in the case of Micco et al (2003). Also, the use of the gravity equation in this format is similar to the strategy employed by Krueger (1999) to estimate trade diversion caused by NAFTA, or Wilhelmsson (2006) to estimate trade displacement effects of the enlarged EU.

In addition to the OLS estimation of equation (3), several other estimations of the data will be presented in section VI. Using the entire sample in the estimation makes the assumption that each coefficient that is estimated is the same for each of the individual importers. For example, the results from this estimation assume that the distance between trading partners has the same effect on France's imports as it does on German imports. The choice of the six largest economies in the EU for the sample data suggests that this

assumption will hold if countries within this group have similar trade policies and relations with outside trading partners. However, on the other hand, given the differences in country characteristics such as location, language, or shared borders among the six countries, arguing against this assumption is not a stretch. For this reason, each individual importer will also have the same equation estimated, providing six different estimations. Though this method results in a reduction of sample size, it will allow for comparison between each individual importer and the overall sample. This comparison will help identify if trade displacement is occurring in individual countries more or less (if at all) than the group of large importers as a whole.

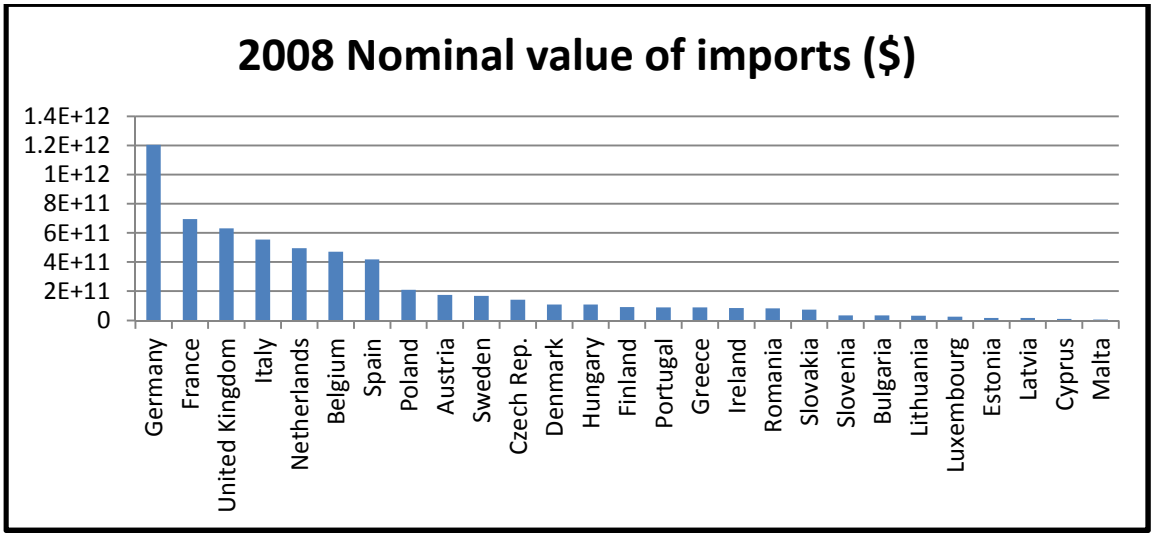
In a similar manner to the importers, in terms of aggregation, splitting the exporters into the four groups – the D_{g_e} variable – makes the assumption that the membership to a particular group influences exports to the large EU economies in the same way and in a different manner than exports from countries of a different group. The similarity of the countries within each of the three European groups is meant to represent two characteristics – one being the level of integration within the EU and the other being a proxy for overall skill level. One objective of this analysis is to examine if the reduction in trade frictions that accompany entrance into the union causes trade displacement within the EU. The countries in the new member group are the countries involved in the enlargement of the EU-15 to EU-25 and EU-27. Of the EU-15 members, they are divided by the size of the economies, with the 'core' members being the same six countries for which the import data was collected. While there would be some reorganization if done strictly, the division of the exporters into groups represents both a depth of integration element as well as a more traditional north/south separation.

Absent from the estimated model are terms that include exchange rates and inflation rates. With import values and per capita GDP reported in U.S. dollars, exchange rate fluctuation should not be ignored. In addition, while per capita GDP is reported in real terms, import values are in nominal values, leaving inflation rate fluctuation as another important aspect of the model. Without adding additional variables, variation in these two terms, country inflation and exchange rates, is captured in the estimated model by the time period dummy variables. Interpretation of the changes in the estimated coefficients for the period dummies will reflect this variation.

V. Descriptive Statistics

Imports to the largest six economies of the EU are used to test the model[34] - Germany, France, the United Kingdom, Italy, Spain, and the Netherlands. These six countries also account for the majority of imports destined for the EU, as can be seen in Figure 3.1. Theses six countries account for approximately two-thirds of all imports destined for the EU.

Figure 3.1 - 2008 Nominal value of imports of selected EU countries



[34]In terms of Nominal GDP according to the CIA World Factbook.

The six economies are also heavily dependent on one another as a source of imports, as can be seen in the table in Appendix II. Noteworthy is the fact that Germany is the top exporter to each of the other five countries in the sample.

While Figure 3.1 and Appendix II provide recent snapshots of imports to the largest economies, of particular importance to the topic of trade displacement are the changes in the sources of their imports, if any. Figures 3.2a through 3.2f demonstrate the changes in the share of imports from select countries. The countries selected are the largest three (other) economies and the two largest new members of the EU-27.

As a cautionary note, trade share alone will not shed a clear light on whether or not the trade displacement effects are significant. As trade creation is expected to take place between the new and old members, that effect alone might result in the share of imports decreasing from other members. For example, if Germany begins to import more goods from the Czech Republic, the share of imports from France may decrease despite Germany's nominal imports from France remaining constant, decreasing, or even increasing. However, as Figure 3.3 shows, examination of the nominal values in this way is difficult to analyze. The nominal values often move in the same direction, particularly after 2002 when imports from nearly every country increased.

With this caution taken into account, Figures 3.2a – 3.2f remain informative. Imports from France and the UK decrease, in terms of import share, by approximately 5%. Considering the large value of imports to these countries – Germany's total imports in 2008 valued $1.2 trillion – a slight change in trade share indicates a fairly large change in nominal import value.

Figure 3.2 a-f – Share of country imports

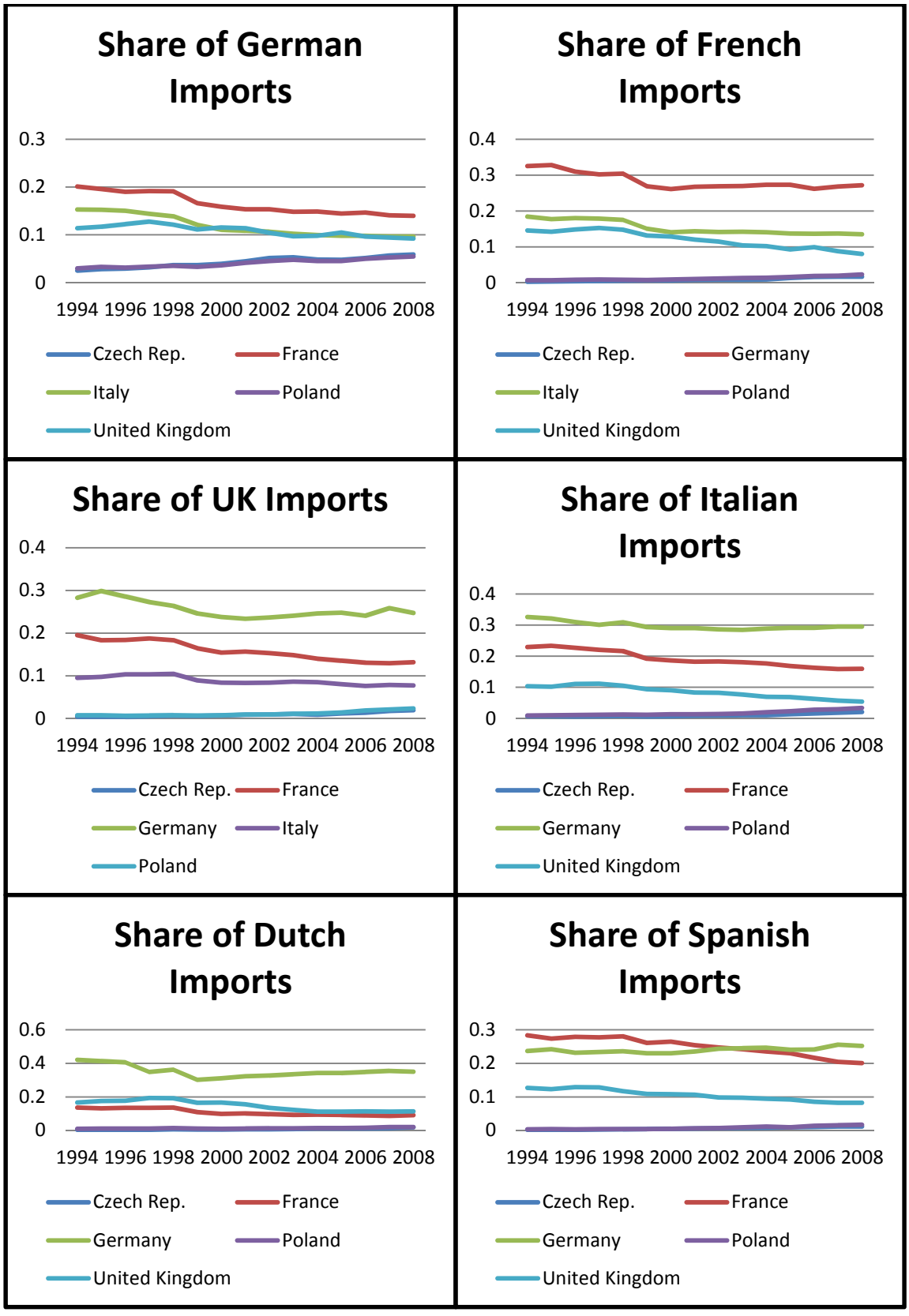
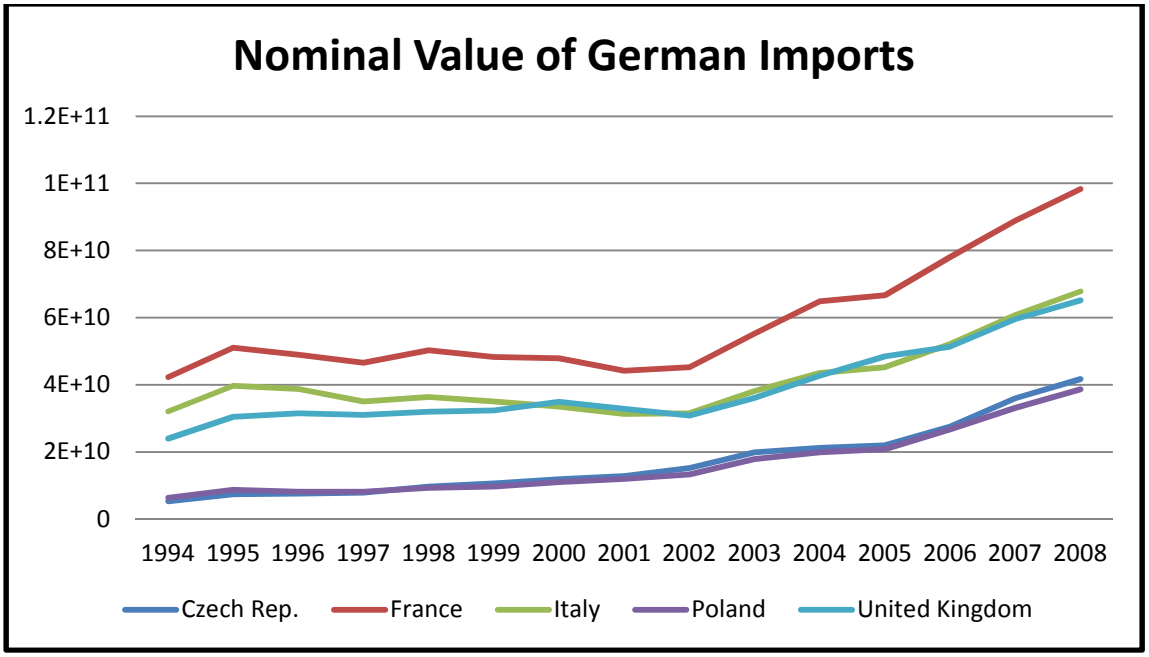


Figure 3.3 - Nominal Value of German Imports



Conversely to imports from France and the UK, imports from Germany to the other large economies of the EU remain much more constant in terms of share of imports. Imports from the Czech Republic and Poland to the large EU economies increase in trade share, particularly in Germany.

VI. Results

A. Entire Sample

The detailed results of the estimation of equation (3) using the entire sample are presented in Appendix IV. The estimated coefficients of the GDPPC, population, and distance variables are all significant and in the direction predicted. The coefficients of the dummy variable and interaction terms are presented in Table 3.1 with standard errors in parentheses:

Table 3.1 OLS estimates of γ (* indicates 95% significance level)

		ROW	New	Core	Other
		g_0	g_1	g_2	g_3
1994-1996	p_0	0.000	-0.728* (0.082)	0.189* (0.094)	0.102 (0.083)
1997-1999	p_1	0.010 (0.074)	0.088 (0.097)	-0.028 (0.124)	-0.072 (0.106)
2000-2002	p_2	0.127 (0.071)	0.096 (0.096)	-0.245* (0.122)	-0.235* (0.103)
2003-2005	p_3	0.429* (0.072)	0.167 (0.096)	-0.299* (0.122)	-0.243* (0.103)
2006-2008	p_4	0.728* (0.072)	0.215* (0.096)	-0.423* (0.122)	-0.368* (0.103)

One important note is that the base estimation (all dummy variables equal to zero) is for the ROW group in the 1994-1996 period. Because the dummy variables are not in logarithmic form, adding the coefficient results in a scaling of the base estimation. For example, the core group estimated coefficient for the 1994-1996 period of 0.189 results in trade originating from the core members being exp(0.189) = 1.208 times the values of imports from the base group, or 20.8% higher, after also including the changes in imports due to the differences in the GDP, POP, and DIST variables.

Because both the individual dummy variables D_{g_e} and D_{p_t} are included along with the interaction of the two[35] in the regression, a conversion of the estimated coefficients is needed before analyzing the results. Define λ with the following stipulations according to the values of *e* and *t* for D_{g_e} and D_{p_t}:

$$\text{If } t = 0 \text{ or } e = 0, \text{ then } \lambda_{g_e,p_t} = \gamma_{g_e,p_t}$$

$$\text{If } t \text{ and } e > 0, \text{ then } \lambda_{g_e,p_t} = \gamma_{g_e,p_t} + \gamma_{g_e,p_0} + \gamma_{g_0,p_t}$$

[35]As indicated above, $D_{g_e}D_{p_0}$ is equivalent to D_{g_e}, and thus, γ_{g_e,p_0} is the estimated coefficient on the (non-interacted) D_{g_e} variable. Similarly, $D_{g_0}D_{p_t}$ is equivalent to D_{p_t} and γ_{g_0,p_t} is the estimated coefficient on the D_{p_t} variable.

So for either of the benchmark cases (ROW or 1994-96 period), the estimated coefficient γ reported in Table 3.1 has the same value for λ. However, because of the inclusion of the non-interacted dummies and the interaction terms, the estimated value of λ is the sum of three estimates of γ: one for the interaction term, and one each for the non-interacted terms.

As an example, a data point of imports to France from Portugal in 2004 would be written as:

$$lnM_{2004}^{FrancePortugal} = lnC + \beta_1 lnGDPPC_{2004}^{France} + \beta_2 lnPOP_{2004}^{France} + \beta_3 lnGDPPC_{2004}^{Portugal} + \beta_4 lnPOP_{2004}^{Potugal} + \beta_5 lnDIST^{FrancePortugal} + \gamma_{g_3,p_0} D_{g_3} + \gamma_{g_0,p_3} D_{p_3} + \gamma_{g_3,p_3} D_{g_3} D_{p_3} + \varepsilon_{2004}^{FrancePotugal}$$

As a more general example of similar imports, the estimated value of λ_{g_3,p_3}, the coefficient for imports from one of the other members in the 2003-2005 period is (-0.243 + 0.429 + 0.102) = 0.288, as all three terms would have a dummy value of 1 in the estimation.[36] Converting to the scale, exp(0.288) = 1.334, or imports to the core from the other members in 2003-2005 are about 133% of the value of imports from the base group after also including the changes in imports due to the differences in GDPs. Table 3.2 presents the estimates of λ for the various exporter groups and periods.

Caution must be taken when interpreting some of these estimated coefficients, as not all estimated coefficients are significantly different than zero[37]. In particular, estimates that include the earlier years (1997-1999) are rarely significant. This may not come as a large surprise, however, as the difference in trade (that is not accounted for by changes to the base

[36] These values are the corresponding estimates of γ from Table 3.1.

[37] See appendix 3 for regression results and tests of significance.

variables GDP, GDPPC, or POP) from the base period to the DY1 period would not be expected to be large.

Table 3.2 OLS estimates of λ (* indicates 95% significance level)

		ROW	New	Core	Other
		g_0	g_1	g_2	g_3
1994-1996	p_0	0.000	-0.728* (0.082)	0.189* (0.094)	0.102 (0.083)
1997-1999	p_1	0.010 (0.074)	-0.629* (0.081)	0.171 (0.094)	0.040 (0.082)
2000-2002	p_2	0.127 (0.071)	-0.505* (0.081)	0.071 (0.094)	-0.006 (0.081)
2003-2005	p_3	0.429* (0.072)	-0.133 (0.080)	0.319* (0.094)	0.288* (0.081)
2006-2008	p_4	0.728* (0.072)	0.216* (0.080)	0.495* (0.095)	0.463* (0.081)

Of particular importance to the issue of trade displacement is the change in the estimated imports from the various groups, as this would allow us to examine if the effects of the various country groups change over time. Namely, examination of $\lambda_{g_e,p_t} - \lambda_{g_e,p_{t-1}}$ will allow analysis of trade displacement in the sample.

Table 3.3 shows the change in estimates of λ_{g_e,p_t} from the previous time period.

Table 3.3 OLS estimates of $\lambda_{g_e,p_t} - \lambda_{g_e,p_{t-1}}$ (* indicates 95% significance level)

		ROW	New	Core	Other
		g_0	g_1	g_2	g_3
1994-1996	p_0	0.000	0.000	0.000	0.000
1997-1999	p_1	0.010 (0.074)	0.098 (0.123)	-0.018 (0.169)	-0.062 (0.138)
2000-2002	p_2	0.117 (0.070)	0.124 (0.064)	-0.101 (0.099)	-0.046 (0.073)
2003-2005	p_3	0.302* (0.067)	0.372* (0.064)	0.248* (0.099)	0.294* (0.070)
2006-2008	p_4	0.300* (0.067)	0.348* (0.065)	0.176 (0.099)	0.175* (0.070)

Evidence of trade displacement would occur if the estimates for the new members were increasing while estimates for the core and/or other members were decreasing, or if the estimates for the new members were increasing faster than those for the core and/or other groups. There is some evidence of trade displacement in the results. The new members show an increase in the estimate of λ in each of the periods over the previous period. In fact, the estimates of λ are increasing at an increasing rate until the last period. In addition, the movement from period 1 to period 2 and again from period 2 to 3 results in a decrease in the estimate of λ for both the core and other members. However, caution should be taken when interpreting these results, as the estimates are not significant for any group in the first three periods. For the core and other members, the estimates increase from the previous period for the final two periods, but are well below the rate at which the estimates are increasing for the new members.

These results provide moderate evidence of trade displacement. In the early periods of the sample, after accounting for the expected changes in imports resulting from changes in populations and GDPPC, the core EU countries are increasing their imports from the new members while decreasing the imports from core and other members. In the later periods of the sample, the core members are importing more from all sources (again, after accounting for changes in populations and GDPPCs), but have increased their imports from the new members by a larger rate than the core or other members.

B. Individual Countries

a. OLS Estimation

A similar model is estimated for each of the individual importing countries to examine if trade displacement is occurring at different levels for the six large importers. The

results from these six regressions are presented in Appendix V, and they are summarized in the Tables 3.4-3.6.

Of particular interest is the analysis of Table 3.6, as trade displacement occurring in the individual countries would be seen in the changes in imports from one period to the next. In nearly every period for each country, the estimated change in λ from the previous period is greater for imports coming from the new members than the corresponding estimate for imports from the core or other members, with the only exceptions being Dutch imports in period 2 and German imports in period 3. Even instances where the corresponding values in Table 3.6 are negative for both the new members and the core or other members, the values are less negative, suggesting the change in imports from new members is not necessarily increasing, but decreasing at a slower rate than imports from the two other groups. This fact suggests that there is some level of trade displacement occurring in the sample, though it occurs in different magnitudes and at different times for the countries in the sample.

For France, there is a larger difference between the estimated change in λ for imports from the new members compared to the core or other members in the first three periods, but only a small difference in period 4, suggesting that any trade displacement occurred early in the sample. In addition, the estimated values for the core and other members are similar throughout, which would indicate that imports are not switching away from only one of those groups. Estimates in the change in λ for German imports are also greater for imports from the new members than the other two groups in the first two periods, but these differences are smaller than that of the estimates for France. In addition, there is nearly no difference between the change in λ for German imports from the new members, core members, or other members in the last two periods of the sample.

Table 3.4 – OLS estimates of γ (* indicates 95% significance level)

FR	ROW	New	Core	Other	**GE**	ROW	New	Core	Other
	g_0	g_1	g_2	g_3		g_0	g_1	g_2	g_3
p_0	0.000	-0.709*	0.355	0.178	p_0	0.000	-0.715*	-0.162	-0.296
		(0.190)	(0.223)	(0.193)			(0.17)	(0.185)	(0.169)
p_1	-0.171	0.155	-0.022	-0.054	p_1	-0.212	0.153	0.042	-0.028
	(0.215)	(0.229)	-0.290	-0.250		(0.193)	(0.195)	(0.247)	(0.213)
p_2	-0.333	0.305	-0.183	-0.122	p_2	-0.288	0.186	-0.176	-0.123
	(0.321)	(0.224)	(0.286)	(0.242)		(0.286)	(0.191)	(0.244)	(0.206)
p_3	-0.245	0.500*	-0.260	-0.213	p_3	0.038	0.151	-0.247	-0.145
	(0.361)	(0.224)	(0.286)	(0.242)		-0.32	(0.191)	(0.244)	(0.206)
p_4	-0.185	0.475*	-0.378	-0.343	p_4	0.143	0.084	-0.323	-0.238
	(0.458)	(0.225)	(0.286)	(0.241)		(0.389)	(0.192)	(0.244)	(0.205)
NE	ROW	New	Core	Other	**SP**	ROW	New	Core	Other
	g_0	g_1	g_2	g_3		g_0	g_1	g_2	g_3
p_0	0.000	0.028	0.056	0.526*	p_0	0.000	-1.182*	0.733*	0.333
		(0.191)	-0.22	(0.193)			(0.176)	(0.209)	(0.181)
p_1	-0.157	0.032	-0.113	-0.048	p_1	-0.143	0.158	-0.032	-0.095
	(0.218)	(0.226)	(0.286)	(0.248)		(0.216)	(0.212)	(0.269)	(0.231)
p_2	-0.096	-0.170	-0.222	-0.159	p_2	-0.269	0.352	-0.307	-0.307
	(0.302)	(0.221)	(0.282)	(0.238)		(0.313)	(0.208)	(0.265)	(0.223)
p_3	0.288	-0.188	-0.367	-0.228	p_3	-0.139	0.344	-0.385	-0.352
	(0.379)	(0.221)	(0.282)	(0.238)		(0.354)	(0.208)	(0.265)	(0.223)
p_4	0.519	-0.167	-0.511	-0.42	p_4	-0.129	0.508*	-0.537*	-0.426
	(0.430)	(0.222)	(0.282)	(0.238)		(0.431)	(0.209)	(0.265)	(0.223)
IT	ROW	New	Core	Other	**UK**	ROW	New	Core	Other
	g_0	g_1	g_2	g_3		g_0	g_1	g_2	g_3
p_0	0.000	-1.244*	0.108	-0.272	p_0	0.000	-0.567*	0.457*	0.359
		(0.194)	(0.220)	(0.195)			(0.186)	-0.22	(0.191)
p_1	-0.118	0.030	0.015	0.021	p_1	0.047	0.024	-0.035	-0.194
	(0.219)	(0.231)	(0.293)	(0.252)		(0.225)	(0.223)	(0.283)	(0.244)
p_2	-0.064	-0.065	-0.340	-0.175	p_2	0.081	-0.004	-0.211	-0.370
	(0.345)	(0.226)	(0.289)	(0.243)		(0.321)	(0.219)	(0.279)	(0.236)
p_3	-0.025	-0.008	-0.368	-0.145	p_3	0.181	0.229	-0.129	-0.217
	(0.376)	(0.226)	(0.289)	(0.243)		(0.386)	(0.219)	(0.279)	(0.236)
p_4	-0.053	0.149	-0.500	-0.257	p_4	0.348	0.289	-0.246	-0.361
	(0.473)	(0.227)	(0.289)	(0.243)		(0.451)	(0.220)	(0.279)	(0.236)

Table 3.5 – OLS estimates of λ (* indicates 95% significance level)

FR	ROW	New	Core	Other	**GE**	ROW	New	Core	Other
	g_0	g_1	g_2	g_3		g_0	g_1	g_2	g_3
p_0	0.000	-0.709*	0.355	0.178	p_0	0.000	-0.715*	-0.162	-0.296
		(0.190)	(0.223)	(0.193)			(0.170)	(0.185)	(0.169)
p_1	-0.171	-0.725*	0.162	-0.047	p_1	-0.212	-0.774*	-0.332	-0.536*
	(0.215)	(0.227)	(0.256)	(0.231)		(0.193)	(0.210)	(0.223)	(0.209)
p_2	-0.333	-0.737*	-0.161	-0.277	p_2	-0.288	-0.817*	-0.626*	-0.707*
	(0.321)	(0.332)	(0.352)	(0.331)		(0.286)	(0.301)	(0.310)	(0.297)
p_3	-0.245	-0.454	-0.150	-0.280	p_3	0.038	-0.526	-0.371	-0.403
	(0.361)	(0.371)	(0.389)	(0.370)		(0.32)	(0.332)	(0.341)	(0.330)
p_4	-0.185	-0.419	-0.208	-0.350	p_4	0.143	-0.488	-0.342	-0.391
	(0.458)	(0.465)	(0.480)	(0.465)		(0.389)	(0.398)	(0.406)	(0.397)
NE	ROW	New	Core	Other	**SP**	ROW	New	Core	Other
	g_0	g_1	g_2	g_3		g_0	g_1	g_2	g_3
p_0	0.000	0.028	0.056	0.526*	p_0	0.000	-1.182*	0.733*	0.333
		(0.191)	(0.22)	(0.193)			(0.176)	(0.209)	(0.181)
p_1	-0.157	-0.097	-0.214	0.321	p_1	-0.143	-1.167*	0.558*	0.095
	(0.218)	(0.233)	(0.257)	(0.235)		(0.216)	(0.226)	(0.253)	(0.232)
p_2	-0.096	-0.238	-0.262	0.271	p_2	-0.269	-1.099*	0.157	-0.243
	(0.302)	(0.317)	(0.335)	(0.316)		(0.313)	(0.323)	(0.343)	(0.323)
p_3	0.288	0.128	-0.023	0.586	p_3	-0.139	-0.977*	0.209	-0.158
	(0.379)	(0.391)	(0.405)	(0.390)		(0.354)	(0.363)	(0.380)	(0.363)
p_4	0.519	0.380	0.064	0.625	p_4	-0.129	-0.803	0.067	-0.222
	(0.43)	(0.439)	(0.453)	(0.440)		(0.431)	(0.438)	(0.453)	(0.439)
IT	ROW	New	Core	Other	**UK**	ROW	New	Core	Other
	g_0	g_1	g_2	g_3		g_0	g_1	g_2	g_3
p_0	0.000	-1.244*	0.108	-0.272	p_0	0.000	-0.567*	0.457*	0.359
		(0.194)	(0.220)	(0.195)			(0.186)	(0.220)	(0.191)
p_1	-0.118	-1.332*	0.005	-0.369	p_1	0.047	-0.496*	0.469	0.212
	(0.219)	(0.237)	(0.256)	(0.234)		(0.225)	(0.237)	(0.264)	(0.241)
p_2	-0.064	-1.373*	-0.296	-0.511	p_2	0.081	-0.490	0.327	0.070
	(0.345)	(0.357)	(0.372)	(0.354)		(0.321)	(0.333)	(0.353)	(0.333)
p_3	-0.025	-1.277*	-0.285	-0.442	p_3	0.181	-0.157	0.509	0.323
	(0.376)	(0.387)	(0.401)	(0.384)		(0.386)	(0.395)	(0.412)	(0.395)
p_4	-0.053	-1.148*	-0.445	-0.582	p_4	0.348	0.070	0.559	0.346
	(0.473)	(0.482)	(0.494)	(0.480)		(0.451)	(0.458)	(0.473)	(0.459)

Table 3.6 OLS estimates $\lambda_{g_e,p_t} - \lambda_{g_e,p_{t-1}}$ (* indicates 95% significance level)

FR	ROW	New	Core	Other	**GE**	ROW	New	Core	Other
	g_0	g_1	g_2	g_3		g_0	g_1	g_2	g_3
p_0	0.000	0.000	0.000	0.000	p_0	0.000	0.000	0.000	0.000
p_1	-0.171	-0.016	-0.193	-0.225	p_1	-0.212	-0.059	-0.170	-0.240
	(0.215)	(0.197)	(0.265)	(0.224)		(0.193)	(0.179)	(0.234)	(0.199)
p_2	-0.162	-0.012	-0.323	-0.230	p_2	-0.076	-0.043	-0.294	-0.171
	(0.220)	(0.211)	(0.277)	(0.223)		(0.188)	(0.180)	(0.236)	(0.191)
p_3	0.088	0.283	0.011	-0.003	p_3	0.326*	0.291*	0.255	0.304*
	(0.214)	(0.209)	(0.275)	(0.220)		(0.140)	(0.135)	(0.203)	(0.147)
p_4	0.060	0.035	-0.058	-0.070	p_4	0.105	0.038	0.029	0.012
	(0.207)	(0.202)	(0.270)	(0.213)		(0.187)	(0.183)	(0.238)	(0.192)
NE	ROW	New	Core	Other	**SP**	ROW	New	Core	Other
	g_0	g_1	g_2	g_3		g_0	g_1	g_2	g_3
p_0	0.000	0.000	0.000	0.000	p_0	0.000	0.000	0.000	0.000
p_1	-0.157	-0.125	-0.270	-0.205	p_1	-0.143	0.015	-0.175	-0.238
	(0.218)	(0.200)	(0.266)	(0.226)		(0.217)	(0.201)	(0.260)	(0.224)
p_2	0.061	-0.141	-0.048	-0.050	p_2	-0.126	0.068	-0.401	-0.338
	(0.214)	(0.205)	(0.270)	(0.220)		(0.201)	(0.193)	(0.254)	(0.204)
p_3	0.384	0.366	0.239	0.315	p_3	0.130	0.122	0.052	0.085
	(0.202)	(0.197)	(0.264)	(0.207)		(0.188)	(0.183)	(0.247)	(0.194)
p_4	0.231	0.252	0.087	0.039	p_4	0.010	0.174	-0.142	-0.064
	(0.195)	(0.191)	(0.259)	(0.201)		(0.193)	(0.188)	(0.250)	(0.198)
IT	ROW	New	Core	Other	**UK**	ROW	New	Core	Other
	g_0	g_1	g_2	g_3		g_0	g_1	g_2	g_3
p_0	0.000	0.000	0.000	0.000	p_0	0.000	0.000	0.000	0.000
p_1	-0.118	-0.088	-0.103	-0.097	p_1	0.047	0.071	0.012	-0.147
	(0.219)	(0.201)	(0.270)	(0.227)		(0.225)	(0.208)	(0.271)	(0.233)
p_2	0.054	-0.041	-0.301	-0.142	p_2	0.034	0.006	-0.142	-0.142
	(0.236)	(0.228)	(0.290)	(0.240)		(0.206)	(0.197)	(0.263)	(0.210)
p_3	0.039	0.096	0.011	0.069	p_3	0.100	0.333	0.182	0.253
	(0.200)	(0.195)	(0.265)	(0.206)		(0.181)	(0.176)	(0.247)	(0.187)
p_4	-0.028	0.129	-0.160	-0.140	p_4	0.167	0.227	0.050	0.023
	(0.213)	(0.208)	(0.275)	(0.219)		(0.206)	(0.201)	(0.266)	(0.212)

Conversely, the estimates for the changes in λ presented in Table 3.6 for Italian imports show the greatest differences between the new members and the core or other members in period 4, suggesting that trade displacement occurred later in the sample. Dutch and British imports both showed some signs of trade displacement in both the third and fourth periods, but to a lesser extent. Also, in each period, the estimate for the core members was lower than that of the other members, suggesting that Italian imports were switching away from the core members as a source. This is also true for Spanish imports in every period except the first. In fact, the estimates of the change in λ for Spain show the largest differences between imports originating from the new members and those originating from either the core or other members, which suggests that Spanish imports showed the most evidence of trade displacement, and that much of this displacement occurred more with the switching of imports away from the core members as a source.

Some observations regarding the significance of the results presented in the above tables when interpreting the results are also warranted. In general, there is a lack of significance at the 95% level for many of the estimates of γ, λ, and changes in λ. Because of this, strong conclusions about the level of trade displacement cannot be made. However, the significance of some of the estimates of λ in Table 3.5, particularly the estimates involving the imports from the new members, does suggest a trend of increasing imports from these countries.

b. SUR Estimation

While the results from the six separate regressions above may provide some information into the trade displacement taking place among the individual countries, unobservable factors in each of the six separate equations are likely correlated across the

equations, resulting in correlation in the error terms, ε_t^{ie}, across regressions. To correct for this, all six equations are estimated simultaneously using the Seemingly Unrelated Regression (SUR) technique. The results from this estimation are presented in Appendix VI. The Breusch-Pagan test confirms that the residuals are not independent, and the seemingly unrelated estimation is a better approach than OLS, which results in inefficient, though still unbiased, estimates. Using this method of estimation, only trade displacement between the new members and the other members can be examined, as the DG2 variable is omitted in the regression. The results for the estimation of the coefficients of the dummy variable and interaction terms are presented in Tables 3.7 - 3.9. Table 3.7 presents the estimates of γ, Table 3.8 presents the estimates of λ, and Table 3.9 presents the change in the estimate of λ from the previous period.

Another advantage of using SUR is that it enables using a straightforward method to test if the estimated coefficients are the same across equations, or across countries in this case. Each estimated coefficient was tested against the estimated coefficient of the corresponding variable for each country pair, as well as across all countries. For example, the null hypothesis that the coefficient of the exporter population is the same in both the estimation for French imports and German imports, and another test is to see if the estimated coefficient is the same for all six countries.

The hypotheses of equality among the estimated coefficients for the five standard gravity variables – population of exporter and importer, per capita GDP of exporter and importer, and the distance variable – was rejected in some cases, but not in others for the pairwise tests. Not surprisingly since each equation was constructed with just the one importer, there were more rejections of the null hypothesis in the cases of the exporter

variables, and the distance variable. This is confirmed by the test across all equations, as seen in Table 3.10.

Also of note is that the hypothesis of equality among the estimated coefficients for the distance variable is rejected in all but one case. As shown in Table 3.11, the effect that distance has on each individual country's imports is different in nearly every case.

Table 3.7 – SUR estimates of γ (* indicates 95% significance level)

Fr	ROW	New	Other	Ger	ROW	New	Other	It	ROW	New	Other
	g_0	g_1	g_3		g_0	g_1	g_3		g_0	g_1	g_3
p_0	0.000	-0.686*	0.167	p_0	0.000	-0.620*	-0.239	p_0	0.000	-1.112*	-0.183
		(0.188)	(0.190)			(0.171)	(0.171)			(0.198)	(0.199)
p_1	-0.154	0.154	-0.048	p_1	-0.152	0.150	-0.011	p_1	-0.054	0.024	0.012
	(0.203)	(0.225)	(0.247)		(0.190)	(0.200)	(0.220)		(0.214)	(0.236)	(0.259)
p_2	-0.282	0.301	-0.127	p_2	-0.150	0.179	-0.127	p_2	0.083	-0.073	-0.177
	(0.292)	(0.221)	(0.238)		(0.277)	(0.196)	(0.211)		(0.319)	(0.232)	(0.249)
p_3	-0.091	0.495*	-0.216	p_3	0.184	0.144	-0.147	p_3	0.217	-0.017	-0.146
	(0.344)	(0.221)	(0.238)		(0.306)	(0.196)	(0.211)		(0.361)	(0.232)	(0.249)
p_4	0.065	0.468*	-0.345	p_4	0.387	0.075	-0.239	p_4	0.309	0.139	-0.258
	(0.435)	(0.222)	(0.238)		(0.379)	(0.197)	(0.211)		(0.456)	(0.232)	(0.249)
Ne	ROW	New	Other	Sp	ROW	New	Other	UK	ROW	New	Other
	g_0	g_1	g_3		g_0	g_1	g_3		g_0	g_1	g_3
p_0	0.000	0.027	0.530*	p_0	0.000	-1.174*	0.335	p_0	0.000	-0.569*	0.376
		(0.194)	(0.196)			(0.181)	(0.184)			(0.191)	(0.195)
p_1	-0.144	0.032	-0.047	p_1	-0.186	0.158	-0.073	p_1	-0.109	0.026	-0.090
	(0.221)	(0.230)	(0.253)		(0.210)	(0.217)	(0.238)		(0.225)	(0.227)	(0.249)
p_2	-0.053	-0.168	-0.153	p_2	-0.310	0.350	-0.308	p_2	-0.177	-0.001	-0.361
	(0.312)	(0.226)	(0.243)		(0.298)	(0.213)	(0.229)		(0.323)	(0.223)	(0.240)
p_3	0.363	-0.186	-0.222	p_3	-0.081	0.342	-0.353	p_3	-0.033	0.232	-0.209
	(0.381)	(0.226)	(0.243)		(0.349)	(0.213)	(0.229)		(0.399)	(0.223)	(0.240)
p_4	0.591	-0.165	-0.415	p_4	0.034	0.505*	-0.427	p_4	0.310	0.289	-0.353
	(0.445)	(0.227)	(0.243)		(0.427)	(0.214)	(0.229)		(0.478)	(0.224)	(0.240)

Table 3.8 – SUR estimates of λ (* indicates 95% significance level)

Fr	ROW	New	Other	Ger	ROW	New	Other	It	ROW	New	Other
	g_0	g_1	g_3		g_0	g_1	g_3		g_0	g_1	g_3
p_0	0.000	-0.686*	0.167	p_0	0.000	-0.620*	-0.239	p_0	0.000	-1.112*	-0.183
		(0.188)	(0.190)			(0.171)	(0.171)			(0.198)	(0.199)
p_1	-0.154	-0.686*	-0.035	p_1	-0.152	-0.622*	-0.403*	p_1	-0.054	-1.142*	-0.224
	(0.203)	(0.217)	(0.219)		(0.190)	(0.206)	(0.205)		(0.214)	(0.229)	(0.230)
p_2	-0.282	-0.667*	-0.241	p_2	-0.150	-0.591*	-0.516	p_2	0.083	-1.103*	-0.277
	(0.292)	(0.306)	(0.304)		(0.277)	(0.290)	(0.287)		(0.319)	(0.333)	(0.330)
p_3	-0.091	-0.281	-0.140	p_3	0.184	-0.292	-0.202	p_3	0.217	-0.912*	-0.112
	(0.344)	(0.355)	(0.353)		(0.306)	(0.318)	(0.316)		(0.361)	(0.373)	(0.370)
p_4	0.065	-0.152	-0.113	p_4	0.387	-0.157	-0.091	p_4	0.309	-0.665	-0.131
	(0.435)	(0.443)	(0.443)		(0.379)	(0.388)	(0.387)		(0.456)	(0.466)	(0.464)
Ne	ROW	New	Other	Sp	ROW	New	Other	UK	ROW	New	Other
	g_0	g_1	g_3		g_0	g_1	g_3		g_0	g_1	g_3
p_0	0.000	0.027	0.530*	p_0	0.000	-1.174*	0.335	p_0	0.000	-0.569*	0.376
	0.000	(0.194)	(0.196)			(0.181)	(0.184)			(0.191)	(0.195)
p_1	-0.144	-0.086	0.340	p_1	-0.186	-1.202*	0.075	p_1	-0.109	-0.653*	0.176
	(0.221)	(0.236)	(0.238)		(0.210)	(0.222)	(0.224)		(0.225)	(0.239)	(0.242)
p_2	-0.053	-0.194	0.324	p_2	-0.310	-1.133*	-0.284	p_2	-0.177	-0.746*	-0.162
	(0.312)	(0.327)	(0.325)		(0.298)	(0.310)	(0.309)		(0.323)	(0.336)	(0.336)
p_3	0.363	0.203	0.671	p_3	-0.081	-0.913*	-0.100	p_3	-0.033	-0.370	0.134
	(0.381)	(0.393)	(0.392)		(0.349)	(0.359)	(0.358)		(0.399)	(0.410)	(0.410)
p_4	0.591	0.453	0.706	p_4	0.034	-0.635	-0.058	p_4	0.310	0.031	0.333
	(0.445)	(0.453)	(0.454)		(0.427)	(0.435)	(0.435)		(0.478)	(0.486)	(0.487)

Table 3.9 – SUR estimates $\lambda_{g_e,p_t} - \lambda_{g_e,p_{t-1}}$ (* indicates 95% significance level)

Fr	ROW	New	Other	Ger	ROW	New	Other	It	ROW	New	Other
	g_0	g_1	g_3		g_0	g_1	g_3		g_0	g_1	g_3
p_1	-0.154	0.000	-0.202	p_1	-0.152	-0.003	-0.164	p_1	-0.054	-0.029	-0.042
	(0.203)	(0.184)	(0.212)		(0.190)	(0.175)	(0.198)		(0.214)	(0.195)	(0.223)
p_2	-0.128	0.019	-0.206	p_2	0.002	0.031	-0.113	p_2	0.137	0.039	-0.052
	(0.208)	(0.199)	(0.215)		(0.187)	(0.179)	(0.193)		(0.227)	(0.218)	(0.234)
p_3	0.191	0.385*	0.101	p_3	0.334*	0.299*	0.314*	p_3	0.134	0.190	0.165
	(0.195)	(0.190)	(0.201)		(0.142)	(0.136)	(0.149)		(0.193)	(0.187)	(0.199)
p_4	0.156	0.129	0.027	p_4	0.203	0.135	0.111	p_4	0.092	0.248	-0.019
	(0.194)	(0.189)	(0.200)		(0.178)	(0.173)	(0.183)		(0.206)	(0.201)	(0.213)
Ne	ROW	New	Other	Sp	ROW	New	Other	UK	ROW	New	Other
	g_0	g_1	g_3		g_0	g_1	g_3		g_0	g_1	g_3
p_1	-0.144	-0.112	-0.190	p_1	-0.186	-0.028	-0.260	p_1	-0.109	-0.084	-0.199
	(0.221)	(0.203)	(0.229)		(0.210)	(0.193)	(0.218)		(0.225)	(0.208)	(0.233)
p_2	0.091	-0.108	-0.015	p_2	-0.124	0.069	-0.359	p_2	-0.068	-0.094	-0.339
	(0.215)	(0.206)	(0.222)		(0.200)	(0.191)	(0.206)		(0.210)	(0.201)	(0.217)
p_3	0.416*	0.397*	0.346	p_3	0.229	0.221	0.184	p_3	0.144	0.377*	0.296
	(0.190)	(0.184)	(0.196)		(0.183)	(0.178)	(0.189)		(0.186)	(0.181)	(0.193)
p_4	0.228	0.250	0.036	p_4	0.115	0.278	0.041	p_4	0.343	0.400*	0.198
	(0.189)	(0.184)	(0.195)		(0.187)	(0.182)	(0.193)		(0.202)	(0.197)	(0.208)

Table 3.10 – Tests of equality across all six equations of SUR for standard gravity model variables

	X^2 (df=5)	Prob>X^2
Exporter Population	143.24	0.000
Importer Population	6.59	0.253
Exporter Per Capita GDP	66.52	0.000
Importer Per Capita GDP	1.34	0.931
Distance	178.44	0.000

Table 3.11 – Test of equality of estimated coefficients of distance variable for each pair of countries. Values are X^2 with p-values in parentheses

	France	Germany	Italy	Netherlands	Spain
Germany	10.41				
	(0.001)				
Italy	103.79	75.65			
	(0.000)	(0.000)			
Netherlands	3.59	19.77	99.59		
	(0.058)	(0.000)	(0.000)		
Spain	7.74	0.19	43.44	18.91	
	(0.005)	(0.666)	(0.000)	(0.000)	
UK	45.97	77.31	161.35	43.44	65.09
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Tests of equality for the estimated changes in imports from each country group over the previous period were also performed, again both by each country pair and across all equations. To clarify, each value in Table 3.9 was tested to see if it was equal to the corresponding value from another country, and they were also tested as a group. The results of the tests reveal that the null hypotheses of equality between the corresponding coefficients can rarely be rejected in the pairwise tests.[38,39] The pairwise tests consist of fifteen tests (similar to that of Table 3.11) for each of the twelve values reported in Table 3.9.

[38] Of the 180 possible pairs of corresponding coefficients, only the case of the change in imports from Other members from periods 1 to 2 for the imports to UK and the Netherlands can the null be rejected, and only at the 90% confidence level.

[39] The results of these tests are available from the author.

The results of the test for equality across all six countries, as opposed to equality between corresponding values for just two countries, are shown in Table 3.12.

Table 3.12 – Test of equality across all six equations of SUR for estimates of changes in total effects (values in Table 3.9)

	X^2 (df=5)	Prob>X^2
ROW, t=1	0.79	0.978
ROW, t=2	3.78	0.581
ROW, t=3	5.21	0.391
ROW, t=4	1.19	0.946
New Member, t=1	0.34	0.997
New Member, t=2	0.79	0.978
New Member, t=3	1.83	0.873
New Member, t=4	2.72	0.743
Other Member, t=1	1.53	0.909
Other Member, t=2	6.65	0.248
Other Member, t=3	2.41	0.790
Other Member, t=4	1.36	0.929

Referring back to Tables 3.7 – 3.9 the results of the SUR do provide some evidence of trade displacement, as the importers are switching away from the other members as a source of imports to the new members. In examining the results in the above tables, particularly Table 3.9, in nearly every case the change in the estimate of λ over the previous period is greater for the new members than the other members. In some cases, the estimate is positive for the new members while negative for the other members, indicating an increase in imports from the new members over the previous period and a decrease in imports from the other members over the previous period, which is considered trade displacement. In addition, in the cases where both estimates of λ for the new members and the other members are positive, a larger value for the new members indicates that imports from those new

members are growing faster than imports from the other members. While these are important results, many of the estimates of λ, and even more so of the estimates of the changes in λ in Table 3.9 are not significant at the 95% level. Therefore, while some conclusions can be reached from the results, definitive statements about trade displacement are difficult to make based on these results.

In analyzing each individual country, nearly all six importers showed evidence of trade displacement in the early periods, p_1 and p_2, of the sample, as shown in the estimates presented in Table 3.9. French and Spanish imports showed the greatest difference in changes between the new members and other members over the previous period. For French imports, estimates for the change in λ for the other members, $\lambda_{g_3,p_t} - \lambda_{g_3,p_{t-1}}$, were negative in the first two periods, while the corresponding changes for the new members had positive estimates of changes in λ. In period 1 for French imports, there was a 0.202 difference between the change in λ from the previous period for the new members compared to the other members, and 0.225, 0.284, and 0.102 differences in periods 2, 3, and 4, respectively, demonstrating that French imports from new members were increasing at rates faster than that of imports from the other members.[40]

For Spanish imports, there are similar results. In the first two periods, the changes in the estimates of λ for the other members are negative, -0.260 and -0.359, while the corresponding estimates for the new members are -0.028 and 0.069 for change in λ in periods 1 and 2, respectively. These differences of 0.231 and 0.427 suggest trade displacement has occurred as Spanish imports increased from the new members but not the other members. In periods 3 and 4, these differences are 0.037 and 0.236.

[40] These differences are equivalent to $\lambda_{g_1,p_t} - \lambda_{g_1,p_{t-1}} - (\lambda_{g_2,p_t} - \lambda_{g_2,p_{t-1}})$. For example, the 0.20 difference referred to in the text is calculated by, from Table 3.9, the 0.000 estimate for (g_1, p_1) minus the -0.202 estimate foe (g_3, p_1).

These estimates follow a similar pattern for the imports to the United Kingdom. The difference between the changes in λ from the previous periods for the new members compared to the corresponding estimate for the other members were 0.116, 0.245, 0.080, and 0.202 for periods 1 through 4, respectively. For Italian imports, the differences in those same estimates are 0.012, 0.091, 0.025, and 0.267; for Dutch imports, the differences in estimates are 0.078, -0.093, 0.052, and 0.214; and for German imports, the differences in estimates are 0.161, 0.144, -0.014, and 0.023. For these three countries, the values of these differences are smaller than those differences in estimates for France, Spain, and to some extent, the U.K. This would suggest that the levels of trade displacement in Germany, the Netherlands, and Italy were smaller than that of France, Spain, and the U.K. As noted earlier in the text, the estimates of the change in λ over the previous period were not always statistically significantly different than zero, so the conclusions made from them must be taken with caution.

VII. Conclusions

The results of the above analysis provide some evidence that trade displacement has occurred as the EU expanded from 15 to 27 countries. The estimates of the models suggest that core EU countries of Germany, France, Netherlands, Italy, Spain, and the United Kingdom have increased the imports sourced from the new members at rates faster than those imports sourced from other members. There is also some evidence that imports from the new members have also increased while imports from other members have decreased after accounting for changes in country characteristics.

There are several extensions of the above analysis which would be useful in further identifying the existence of trade displacement. As explained above, the selection of

countries in the sample may have biased the results, with the imports from the ROW group appearing larger than normal. This, however, should not have any overly significant effects, as the magnitudes of the estimates are not as vital as the changes in those estimates over time. Secondly, the countries are currently grouped for the duration of the sample. Allowing the country groups to vary over time – the new members were part of the ROW until accession in reality – could change the results. Perhaps also including a group for potential new member countries would be helpful as well. Thirdly, adding addition binary variables for characteristics such as a shared border or language would help increase the accuracy of the estimates. Finally, changing the year groupings to match significant changes in EU membership might also allow for more interesting interpretations.

Nevertheless, the above analysis does provide some evidence, though not definitive, that trade displacement has occurred within the EU over the past years. As the EU continues to examine the implications of further enlargement, the trade displacement effects should be a factor in each member's endorsement of future enlargement.

APPENDICES

Appendix I: Equations for the four-country Ricardian Model.

The following equations define the percentage change in the crossover goods.

$$\hat{z}_1 = \left(\frac{1}{\alpha_2}\right)(\hat{\tau}_{12} + \hat{\Omega}_2)$$

$$\hat{z}_2 = \left(\frac{1}{\alpha_2}\right)(\hat{\tau}_{31} - \hat{\tau}_{32} + \hat{\Omega}_2)$$

$$\hat{z}_3 = \left(\frac{1}{\alpha_2}\right)(\hat{\tau}_{41} - \hat{\tau}_{42} + \hat{\Omega}_2)$$

$$\hat{z}_4 = \left(\frac{1}{\alpha_2}\right)(-\hat{\tau}_{12} + \hat{\Omega}_2)$$

$$\hat{z}_5 = \left(\frac{1}{\alpha_2 - \alpha_3}\right)(-\hat{\tau}_{32} + \hat{\Omega}_2 - \hat{\Omega}_3)$$

$$\hat{z}_6 = \left(\frac{1}{\alpha_2 - \alpha_3}\right)(\hat{\tau}_{43} - \hat{\tau}_{42} + \hat{\Omega}_2 - \hat{\Omega}_3)$$

$$\hat{z}_7 = \left(\frac{1}{\alpha_2 - \alpha_3}\right)(\hat{\tau}_{13} - \hat{\tau}_{12} + \hat{\Omega}_2 - \hat{\Omega}_3)$$

$$\hat{z}_8 = \left(\frac{1}{\alpha_2 - \alpha_3}\right)(\hat{\tau}_{23} + \hat{\Omega}_2 - \hat{\Omega}_3)$$

$$\hat{z}_9 = \left(\frac{1}{\alpha_3 - \alpha_4}\right)(-\hat{\tau}_{43} + \hat{\Omega}_3 - \hat{\Omega}_4)$$

$$\hat{z}_{10} = \left(\frac{1}{\alpha_3 - \alpha_4}\right)(\hat{\tau}_{14} - \hat{\tau}_{13} + \hat{\Omega}_3 - \hat{\Omega}_4)$$

$$\hat{z}_{11} = \left(\frac{1}{\alpha_3 - \alpha_4}\right)(\hat{\tau}_{24} - \hat{\tau}_{23} + \hat{\Omega}_3 - \hat{\Omega}_4)$$

$$\hat{z}_{12} = \left(\frac{1}{\alpha_3 - \alpha_4}\right)(\hat{\tau}_{34} + \hat{\Omega}_3 - \hat{\Omega}_4)$$

The trade balance equations, restated in percentage change form, are

$$0 = \eta_1\varepsilon_1\hat{z}_1 + \varepsilon_1\left(\hat{\ell}_2 - \hat{\Omega}_2\right) + \eta_2\varepsilon_2\hat{z}_2 + \varepsilon_2\left(\hat{\ell}_3 - \hat{\Omega}_3\right) + \eta_3\varepsilon_3\hat{z}_3 + \varepsilon_3\left(\hat{\ell}_4 - \hat{\Omega}_4\right) + \eta_4(1 - \varepsilon_1 - \varepsilon_2 - \varepsilon_3)\,\hat{z}_4$$

$$0 = \eta_7\varepsilon_7\hat{z}_7 + \varepsilon_7\left(\hat{\Omega}_2 - \hat{\ell}_2\right) - \eta_4\varepsilon_4\hat{z}_4 - \varepsilon_4\left(\hat{\Omega}_2 - \hat{\ell}_2\right) + \eta_6\varepsilon_6\hat{z}_6 + \varepsilon_6\left(\hat{\ell}_4 + \hat{\Omega}_2 - \hat{\ell}_2 - \hat{\Omega}_4\right) - \eta_3\varepsilon_3\hat{z}_3$$
$$- \gamma_3\left(\hat{\ell}_4 + \hat{\Omega}_2 - \hat{\ell}_2 - \hat{\Omega}_4\right) + \eta_5\varepsilon_5\hat{z}_5 + \varepsilon_5\left(\hat{\ell}_3 + \hat{\Omega}_2 - \hat{\ell}_2 - \hat{\Omega}_3\right) - \eta_2\varepsilon_2\hat{z}_2$$
$$- \gamma_2\left(\hat{\ell}_3 + \hat{\Omega}_2 - \hat{\ell}_2 - \hat{\Omega}_3\right) + \eta_8\varepsilon_8\hat{z}_8 - \eta_1\gamma_1\hat{z}_1$$
$$0 = \eta_9\varepsilon_9\hat{z}_9 + \eta_{10}\varepsilon_{10}\hat{z}_{10} - \varepsilon_{10}\left(\hat{\Omega}_4 - \hat{\ell}_4\right) + \eta_{11}\varepsilon_{11}\hat{z}_{11} - \varepsilon_{11}\left(\hat{\ell}_2 + \hat{\Omega}_4 - \hat{\ell}_4 - \hat{\Omega}_2\right) + \eta_{12}\varepsilon_{12}\hat{z}_{12}$$
$$+ \varepsilon_{12}(\hat{\ell}_3 + \hat{\Omega}_4 - \hat{\ell}_4 - \hat{\Omega}_3)$$

With the coefficients defined as:

$$\alpha_j = \left(\frac{\partial A_j}{\partial z}\right)\left(\frac{z}{A_j}\right), \quad j = 2,3,4\ ;\ \alpha_j < 0$$

$$\eta_i = \left(\frac{\partial \theta}{\partial z_i}\right)\left(\frac{z_i}{\theta}\right)\ for\ i = 1,2,3,4,5,6,7,8\ ;\ \eta_i > 0$$

$$\eta_j = \left(\frac{\partial \theta}{\partial z_j}\right)\left(\frac{z_j}{1-\theta}\right)\ for\ j = 9,10,11,12\ ;\ \eta_j > 0$$

$$\varepsilon_1 = \theta(z_1)\,\ell_2/\Omega_2 > 0$$

$$\varepsilon_2 = \theta(z_2)\,\ell_3/\Omega_3 > 0$$

$$\varepsilon_3 = \theta(z_3)\,\ell_4/\Omega_4 > 0$$

$$\varepsilon_4 = \theta(z_4)\,\ell_2/\Omega_2 > 0$$

$$\varepsilon_5 = \theta(z_5)\,\ell_3\Omega_2/\ell_2\Omega_3 > 0$$

$$\varepsilon_6 = \theta(z_6)\,\ell_4\Omega_2/\ell_2\Omega_4 > 0$$

$$\varepsilon_7 = \theta(z_7)\,\Omega_2/\ell_2 > 0$$

$$\varepsilon_8 = \theta(z_8) > 0$$

$$\varepsilon_9 = 1 - \theta(z_9) > 0$$

$$\varepsilon_{10} = \left(1 - \theta(z_{10})\right)\Omega_4/\ell_4 > 0$$

$$\varepsilon_{11} = \left(1 - \theta(z_{11})\right)\ell_2\Omega_4/\ell_4\Omega_2 > 0$$

$$\varepsilon_{12} = 1 - \varepsilon_9 - \varepsilon_{10} - \varepsilon_{11} > 0$$

$$\gamma_1 = \theta(z_1) > 0$$

$$\gamma_2 = \theta(z_2)\,\ell_3\Omega_2/\ell_2\Omega_3 > 0$$

$$\gamma_3 = \theta(z_3)\,\ell_4\Omega_2/\ell_2\Omega_4 > 0$$

Substitution of the crossover goods into trade balance equations yields:

$$\begin{bmatrix} A & B & C \\ D & E & F \\ G & H & I \end{bmatrix}\begin{bmatrix} \hat{\Omega}_2 \\ \hat{\Omega}_3 \\ \hat{\Omega}_4 \end{bmatrix} = \begin{bmatrix} b_1 & c_1 & d_1 \\ b_2 & c_2 & d_2 \\ b_3 & c_3 & d_3 \\ b_4 & c_4 & d_4 \\ b_5 & c_5 & d_5 \\ b_6 & c_6 & d_6 \\ b_7 & c_7 & d_7 \\ b_8 & c_8 & d_8 \\ b_9 & c_9 & d_9 \\ b_{10} & c_{10} & d_{10} \\ b_{11} & c_{11} & d_{11} \\ b_{12} & c_{12} & d_{12} \\ b_{13} & c_{13} & d_{13} \\ b_{14} & c_{14} & d_{14} \\ b_{15} & c_{15} & d_{15} \end{bmatrix}' \begin{bmatrix} \hat{\ell}_2 \\ \hat{\ell}_3 \\ \hat{\ell}_4 \\ \hat{\tau}_{12} \\ \hat{\tau}_{13} \\ \hat{\tau}_{14} \\ \hat{\tau}_{21} \\ \hat{\tau}_{23} \\ \hat{\tau}_{24} \\ \hat{\tau}_{31} \\ \hat{\tau}_{32} \\ \hat{\tau}_{34} \\ \hat{\tau}_{41} \\ \hat{\tau}_{42} \\ \hat{\tau}_{43} \end{bmatrix}$$

Where

$$A = \frac{1}{\alpha_2}[\varepsilon_1(\eta_1 - \alpha_2) + \eta_2\varepsilon_2 + \eta_3\varepsilon_3 + \eta_4(1 - \varepsilon_1 - \varepsilon_2 - \varepsilon_3)] < 0$$

$$B = -\varepsilon_2 < 0$$

$$C = -\varepsilon_3 < 0$$

$$D = \left(\frac{1}{\alpha_2 - \alpha_3}\right)\left[\varepsilon_7\left(\eta_7 + (\alpha_2 - \alpha_3)\right) + \varepsilon_6\left(\eta_6 + (\alpha_2 - \alpha_3)\right) + \varepsilon_5\left(\eta_5 + (\alpha_2 - \alpha_3)\right) + \varepsilon_8\eta_8\right]$$

$$-\frac{1}{\alpha_2}[\varepsilon_4(\eta_4 + \alpha_2) + \gamma_3(\eta_3 + \alpha_2) + \gamma_2(\eta_2 + \alpha_2) + \gamma_1\eta_1] > 0$$

$$E = -\left(\frac{1}{\alpha_2 - \alpha_3}\right)\left[\varepsilon_8\eta_8 - \varepsilon_7\eta_7 + \varepsilon_6\eta_6 + \varepsilon_5\left(\eta_5 + (\alpha_2 - \alpha_3)\right) - \gamma_2(\alpha_2 - \alpha_3)\right] < 0$$

$$F = -\varepsilon_6 + \gamma_3 < 0$$

$$G = -\varepsilon_{11} < 0$$

$$H = \left(\frac{1}{\alpha_3 - \alpha_4}\right)\left[\varepsilon_9\eta_9 - \varepsilon_{10}\eta_{10} + \varepsilon_{11}\eta_{11} + \varepsilon_{12}\left(\eta_{12} + (\alpha_3 - \alpha_4)\right)\right] > 0$$

$$I = -\left(\frac{1}{\alpha_2 - \alpha_3}\right)\left[\varepsilon_9\eta_9 + \varepsilon_{10}\left(\eta_{10} + (\alpha_2 - \alpha_3)\right) + \varepsilon_{11}\left(\eta_{11} + (\alpha_2 - \alpha_3)\right) + \varepsilon_{12}\left(\eta_{12} + (\alpha_2 - \alpha_3)\right)\right]$$

$$< 0$$

$$b_1 = -\varepsilon_1 < 0$$

$$b_2 = -\varepsilon_2 < 0$$

$$b_3 = -\varepsilon_3 < 0$$

$$b_4 = \frac{1}{\alpha_2}\eta_4(1 - \varepsilon_1 - \varepsilon_2 - \varepsilon_3) < 0$$

$$b_5 = 0$$

$$b_6 = 0$$

$$b_7 = -\frac{1}{\alpha_2}\eta_1\varepsilon_1$$

$$b_8 = 0$$

$$b_9 = 0$$

$$b_{10} = -\frac{1}{\alpha_2}\eta_2\varepsilon_2$$

$$b_{11} = \frac{1}{\alpha_2}\eta_2\varepsilon_2$$

$$b_{12} = 0$$

$$b_{13} = -\frac{1}{\alpha_2}\eta_3\varepsilon_3$$

$$b_{14} = \frac{1}{\alpha_2}\eta_3\varepsilon_3$$

$$b_{15} = 0$$

$$c_1 = \varepsilon_7 - \varepsilon_4 + \varepsilon_6 - \gamma_3 + \varepsilon_5 - \gamma_2 > 0$$

$$c_2 = -\varepsilon_5 + \gamma_2 < 0$$

$$c_3 = -\varepsilon_6 + \gamma_3 < 0$$

$$c_4 = \left(\frac{1}{\alpha_2 - \alpha_3}\right)\varepsilon_7\eta_7 - \frac{1}{\alpha_2}\varepsilon_4\eta_4 > 0$$

$$c_5 = -\left(\frac{1}{\alpha_2 - \alpha_3}\right)\varepsilon_7\eta_7 < 0$$

$$c_6 = 0$$

$$c_7 = \frac{1}{\alpha_2}\eta_1\gamma_1 < 0$$

$$c_8 = -\left(\frac{1}{\alpha_2 - \alpha_3}\right)\varepsilon_8\eta_8 < 0$$

$$c_9 = 0$$

$$c_{10} = \frac{1}{\alpha_2}\eta_2\gamma_2 < 0$$

$$c_{11} = \left(\frac{1}{\alpha_2 - \alpha_3}\right)\varepsilon_5\eta_5 - \frac{1}{\alpha_2}\gamma_2\eta_2 > 0$$

$$c_{12} = 0$$

$$c_{13} = \frac{1}{\alpha_2}\eta_3\gamma_3 < 0$$

$$c_{14} = \left(\frac{1}{\alpha_2 - \alpha_3}\right)\varepsilon_6\eta_6 - \frac{1}{\alpha_2}\gamma_3\eta_3 > 0$$

$$c_{15} = -\left(\frac{1}{\alpha_2 - \alpha_3}\right)\varepsilon_6\eta_6 < 0$$

$$d_1 = \varepsilon_{11} > 0$$

$$d_2 = \varepsilon_{12} > 0$$

$$d_3 = -\varepsilon_{10} - \varepsilon_{11} - \varepsilon_{12} < 0$$

$$d_4 = 0$$

$$d_5 = \left(\frac{1}{\alpha_3 - \alpha_4}\right)\varepsilon_{10}\eta_{10} > 0$$

$$d_6 = -\left(\frac{1}{\alpha_3 - \alpha_4}\right)\varepsilon_{10}\eta_{10} < 0$$

$$d_7 = 0$$

$$d_8 = \left(\frac{1}{\alpha_3 - \alpha_4}\right)\varepsilon_{11}\eta_{11} > 0$$

$$d_9 = -\left(\frac{1}{\alpha_3 - \alpha_4}\right)\varepsilon_{11}\eta_{11} < 0$$

$$d_{10} = 0$$

$$d_{11} = 0$$

$$d_{12} = -\left(\frac{1}{\alpha_3 - \alpha_4}\right)\varepsilon_{12}\eta_{12} < 0$$

$$d_{13} = 0$$

$$d_{14} = 0$$

$$d_{15} = \left(\frac{1}{\alpha_3 - \alpha_4}\right)\varepsilon_{9}\eta_{9} > 0$$

Appendix II: Top ten sources of imports for selected countries (Value in $B)

France				Netherlands			
Rank		Value	Share	**Rank**		Value	Share
1	Germany	113.90	16.4%	**1**	Germany	95.21	19.2%
2	Belgium	59.13	8.5%	**2**	Belgium	49.94	10.1%
3	Italy	56.494	8.1%	**3**	USA	39.95	8.1%
4	China	45.46	6.5%	**4**	China	36.83	7.4%
5	Spain	45.31	6.5%	**5**	United Kingdom	31.27	6.3%
6	USA	38.29	5.5%	**6**	France	24.87	5.0%
7	United Kingdom	33.67	4.8%	**7**	Russian Federation	19.20	3.9%
8	Netherlands	28.17	4.1%	**8**	Japan	13.98	2.8%
9	Russian Federation	20.15	2.9%	**9**	Norway	12.56	2.5%
10	Switzerland	15.69	2.3%	**10**	Italy	11.73	2.4%
SUM		456.32	65.7%	**SUM**		335.59	67.8%
Germany				**Spain**			
Rank		Value	Share	**Rank**		Value	Share
1	Netherlands	105.97	8.8%	**1**	Germany	58.37	13.9%
2	France	98.29	8.2%	**2**	France	46.50	11.1%
3	China	86.71	7.2%	**3**	Italy	32.18	7.7%
4	Italy	67.80	5.6%	**4**	China	30.27	7.2%
5	USA	67.63	5.6%	**5**	United Kingdom	19.24	4.6%
6	United Kingdom	65.13	5.4%	**6**	USA	16.70	4.0%
7	Belgium	58.72	4.9%	**7**	Netherlands	15.90	3.8%
8	Russian Federation	52.84	4.4%	**8**	Portugal	13.74	3.3%
9	Austria	48.70	4.0%	**9**	Russian Federation	11.07	2.6%
10	Switzerland	46.35	3.8%	**10**	Belgium	10.52	2.5%
SUM		698.18	58.0%	**SUM**		254.55	60.8%
Italy				**U.K.**			
Rank		Value	Share	**Rank**		Value	Share
1	Germany	86.763	15.7%	**1**	Germany	82.23	13.0%
2	France	46.98	8.5%	**2**	USA	55.24	8.7%
3	China	34.62	6.3%	**3**	China	50.00	7.9%
4	Netherlands	28.12	5.1%	**4**	Netherlands	46.35	7.3%
5	Spain	21.63	3.9%	**5**	France	43.83	6.9%
6	Libya	21.29	3.8%	**6**	Norway	37.45	5.9%
7	Belgium	20.98	3.8%	**7**	Belgium	29.27	4.6%
8	USA	17.20	3.1%	**8**	Italy	25.68	4.1%
9	Switzerland	16.59	3.0%	**9**	Ireland	22.17	3.5%
10	United Kingdom	15.87	2.9%	**10**	Spain	18.91	3.0%
SUM		310.09	56.0%	**SUM**		411.18	65.1%

Appendix III: Expanded regression equation for gravity model:

$$M_t^{ie} = C + \beta_1 lnGDPPC_t^i + \beta_2 lnPOP_t^i + \beta_3 lnGDPPC_t^e + \beta_4 lnPOP_t^e + \beta_5 lnDIST^{ie}$$

$$+\gamma_{0,1} D_{97-99} + \gamma_{0,2} D_{00-02} + \gamma_{0,3} D_{03-05} + \gamma_{0,4} D_{06-08}$$

$$+\gamma_{1,0} D_{new} + \gamma_{2,0} D_{core} + \gamma_{3,0} D_{other}$$

$$+\gamma_{1,1} D_{new} D_{97-99} + \gamma_{1,2} D_{new} D_{00-02} + \gamma_{1,3} D_{new} D_{03-05} + \gamma_{1,4} D_{new} D_{06-08}$$

$$+\gamma_{2,1} D_{core} D_{97-99} + \gamma_{2,2} D_{core} D_{00-02} + \gamma_{1,3} D_{core} D_{03-05} + \gamma_{1,4} D_{core} D_{06-08}$$

$$+\gamma_{3,1} D_{other} D_{97-99} + \gamma_{3,2} D_{other} D_{00-02} + \gamma_{3,3} D_{other} D_{03-05} + \gamma_{3,4} D_{other} D_{06-08}$$

$$+\varepsilon_t^{ie}$$

Appendix IV: OLS results for estimation of entire sample (*,**, and *** represent significance at the 90%,95%, and 99% levels, respectively)

	OLS			OLS with robust SE		
	Coeff	SE		Coeff	SE	
ln POP e	0.830	0.012	**	0.830	0.013	**
ln POP i	0.769	0.022	**	0.769	0.022	**
ln GDPPC e	0.715	0.016	**	0.715	0.015	**
ln GDPPC i	1.004	0.063	**	1.004	0.062	**
ln DIST	-0.848	0.019	**	-0.848	0.021	**
DG1	-0.728	0.082	**	-0.728	0.081	**
DG2	0.189	0.094	**	0.189	0.073	**
DG3	0.102	0.083		0.102	0.075	
DY1	0.010	0.074		0.010	0.064	
DY2	0.127	0.071		0.127	0.066	
DY3	0.429	0.072	**	0.429	0.069	**
DY4	0.728	0.072	**	0.728	0.070	**
DG1*DY1	0.088	0.097		0.088	0.099	
DG1*DY2	0.096	0.096		0.096	0.099	
DG1*DY3	0.167	0.096		0.167	0.100	
DG1*DY4	0.215	0.096	**	0.215	0.099	**
DG2*DY1	-0.028	0.124		-0.028	0.095	
DG2*DY2	-0.245	0.122	**	-0.245	0.097	**
DG2*DY3	-0.299	0.122	**	-0.299	0.103	**
DG2*DY4	-0.423	0.122	**	-0.423	0.106	**
DG3*DY1	-0.072	0.106		-0.072	0.095	
DG3*DY2	-0.235	0.103	**	-0.235	0.094	**
DG3*DY3	-0.243	0.103	**	-0.243	0.094	**
DG3*DY4	-0.368	0.103	**	-0.368	0.095	**
Const	-16.404	0.828	**	-16.404	0.813	**
R-squared	0.876			0.876		

Appendix V: OLS estimation of individual country data (*,**, and *** represent significance at the 90%,95%, and 99% levels, respectively)

	France			Germany			Italy		
	Coeff	SE	Signif	Coeff	SE	Signif	Coeff	SE	Signif
ln POP e	0.839	0.028	***	0.808	0.023	***	0.858	0.029	***
ln POP i	9.945	8.721		-8.724	18.306		13.461	6.384	**
ln GDPPC e	0.736	0.038	***	0.790	0.033	***	0.624	0.039	***
ln GDPPC i	1.868	2.910		3.935	1.926	**	3.577	2.728	
ln DIST	-0.767	0.046	***	-0.906	0.037	***	-1.296	0.051	***
DG1	-0.709	0.190	***	-0.715	0.170	***	-1.244	0.194	***
DG2	0.355	0.223		-0.162	0.185		0.108	0.220	
DG3	0.178	0.193		-0.296	0.169	*	-0.272	0.195	
DY1	-0.171	0.215		-0.212	0.193		-0.118	0.219	
DY2	-0.333	0.321		-0.288	0.286		-0.064	0.345	
DY3	-0.245	0.361		0.038	0.320		-0.025	0.376	
DY4	-0.185	0.458		0.143	0.389		-0.053	0.473	
DG1*DY1	0.155	0.229		0.153	0.195		0.030	0.231	
DG1*DY2	0.305	0.224		0.186	0.191		-0.065	0.226	
DG1*DY3	0.500	0.224	**	0.151	0.191		-0.008	0.226	
DG1*DY4	0.475	0.225	**	0.084	0.192		0.149	0.227	
DG2*DY1	-0.022	0.290		0.042	0.247		0.015	0.293	
DG2*DY2	-0.183	0.286		-0.176	0.244		-0.340	0.289	
DG2*DY3	-0.260	0.286		-0.247	0.244		-0.368	0.289	
DG2*DY4	-0.378	0.286		-0.323	0.244		-0.500	0.289	*
DG3*DY1	-0.054	0.250		-0.028	0.213		0.021	0.252	
DG3*DY2	-0.122	0.242		-0.123	0.206		-0.175	0.243	
DG3*DY3	-0.213	0.242		-0.145	0.206		-0.145	0.243	
DG3*DY4	-0.343	0.241		-0.238	0.205		-0.257	0.243	
Const	-190.044	136.530		128.009	334.495		-264.509	116.801	**
R-squared	0.8851			0.8895			0.8744		
	Netherlands			Spain			UK		
	Coeff	SE	Signif	Coeff	SE	Signif	Coeff	SE	Signif
ln POP e	0.958	0.027	***	0.827	0.026	***	0.703	0.027	***
ln POP i	-6.128	10.738		4.323	3.216		4.096	11.829	
ln GDPPC e	0.802	0.038	***	0.621	0.036	***	0.762	0.037	***
ln GDPPC i	3.482	2.209		3.251	1.624	**	1.042	2.420	
ln DIST	-0.692	0.044	***	-0.905	0.057	***	-0.442	0.048	***
DG1	0.028	0.191		-1.182	0.176	***	-0.567	0.186	***
DG2	0.056	0.220		0.733	0.209	***	0.457	0.220	**
DG3	0.526	0.193	***	0.333	0.181	*	0.359	0.191	*
DY1	-0.157	0.218		-0.143	0.216		0.047	0.225	
DY2	-0.096	0.302		-0.269	0.313		0.081	0.321	
DY3	0.288	0.379		-0.139	0.354		0.181	0.386	
DY4	0.519	0.430		-0.129	0.431		0.348	0.451	
DG1*DY1	0.032	0.226		0.158	0.212		0.024	0.223	
DG1*DY2	-0.170	0.221		0.352	0.208	*	-0.004	0.219	
DG1*DY3	-0.188	0.221		0.344	0.208	*	0.229	0.219	
DG1*DY4	-0.167	0.222		0.508	0.209	**	0.289	0.220	
DG2*DY1	-0.113	0.286		-0.032	0.269		-0.035	0.283	
DG2*DY2	-0.222	0.282		-0.307	0.265		-0.211	0.279	
DG2*DY3	-0.367	0.282		-0.385	0.265		-0.129	0.279	
DG2*DY4	-0.511	0.282	*	-0.537	0.265	**	-0.246	0.279	
DG3*DY1	-0.048	0.248		-0.095	0.231		-0.194	0.244	
DG3*DY2	-0.159	0.238		-0.307	0.223		-0.370	0.236	
DG3*DY3	-0.228	0.238		-0.352	0.223		-0.217	0.236	
DG3*DY4	-0.420	0.238	*	-0.426	0.223	*	-0.361	0.236	
Const	69.010	160.975		-98.477	48.458	**	-77.660	192.642	
R-squared	0.8908			0.9168			0.8715		

Appendix VI: SUR Estimation results (*,**, and *** represent significance at the 90%,95%, and 99% levels, respectively)

	France			Germany			Italy		
	Coeff	SE		Coeff	SE		Coeff	SE	
ln POP e	0.845	0.028	***	0.824	0.024	***	0.855	0.029	***
ln POP i	4.388	6.496		-6.261	13.773		8.584	5.387	
ln GDPPC e	0.756	0.038	***	0.809	0.034	***	0.629	0.040	***
ln GDPPC i	2.475	2.226		2.428	1.824		2.448	2.410	
ln DIST	-0.768	0.036	***	-0.881	0.028	***	-1.194	0.037	***
DG1	-0.686	0.188	***	-0.620	0.171	***	-1.112	0.198	***
DG2	(omitted)			(omitted)			(omitted)		
DG3	0.167	0.190		-0.239	0.171		-0.183	0.199	
DY1	-0.154	0.203		-0.152	0.190		-0.054	0.214	
DY2	-0.282	0.292		-0.150	0.277		0.083	0.319	
DY3	-0.091	0.344		0.184	0.306		0.217	0.361	
DY4	0.065	0.435		0.387	0.379		0.309	0.456	
DG1*DY1	0.154	0.225		0.150	0.200		0.024	0.236	
DG1*DY2	0.301	0.221		0.179	0.196		-0.073	0.232	
DG1*DY3	0.495	0.221	**	0.144	0.196		-0.017	0.232	
DG1*DY4	0.468	0.222	**	0.075	0.197		0.139	0.232	
DG2*DY1	(omitted)			(omitted)			(omitted)		
DG2*DY2	(omitted)			(omitted)			(omitted)		
DG2*DY3	(omitted)			(omitted)			(omitted)		
DG2*DY4	(omitted)			(omitted)			(omitted)		
DG3*DY1	-0.048	0.247		-0.011	0.220		0.012	0.259	
DG3*DY2	-0.127	0.238		-0.127	0.211		-0.177	0.249	
DG3*DY3	-0.216	0.238		-0.147	0.211		-0.146	0.249	
DG3*DY4	-0.345	0.238		-0.239	0.211		-0.258	0.249	
Const	-96.992	105.237		97.480	255.123		-167.178	103.642	
R-squared	0.856			0.867			0.836		
	Netherlands			Spain			UK		
	Coeff	SE		Coeff	SE		Coeff	SE	
ln POP e	0.952	0.028	***	0.828	0.027	***	0.694	0.028	***
ln POP i	-8.589	8.173		1.463	2.579		-16.151	9.500	*
ln GDPPC e	0.801	0.039	***	0.626	0.037	***	0.758	0.038	***
ln GDPPC i	3.752	1.655	**	3.947	1.406	***	4.678	2.109	**
ln DIST	-0.677	0.041	***	-0.901	0.043	***	-0.413	0.050	***
DG1	0.027	0.194		-1.174	0.181	***	-0.569	0.191	***
DG2	(omitted)			(omitted)			(omitted)		
DG3	0.530	0.196	***	0.335	0.184	*	0.376	0.195	*
DY1	-0.144	0.221		-0.186	0.210		-0.109	0.225	
DY2	-0.053	0.312		-0.310	0.298		-0.177	0.323	
DY3	0.363	0.381		-0.081	0.349		-0.033	0.399	
DY4	0.591	0.445		0.034	0.427		0.310	0.478	
DG1*DY1	0.032	0.230		0.158	0.217		0.026	0.227	
DG1*DY2	-0.168	0.226		0.350	0.213		-0.001	0.223	
DG1*DY3	-0.186	0.226		0.342	0.213		0.232	0.223	
DG1*DY4	-0.165	0.227		0.505	0.214	**	0.289	0.224	
DG2*DY1	(omitted)			(omitted)			(omitted)		
DG2*DY2	(omitted)			(omitted)			(omitted)		
DG2*DY3	(omitted)			(omitted)			(omitted)		
DG2*DY4	(omitted)			(omitted)			(omitted)		
DG3*DY1	-0.047	0.253		-0.073	0.238		-0.090	0.249	
DG3*DY2	-0.153	0.243		-0.308	0.229		-0.361	0.240	
DG3*DY3	-0.222	0.243		-0.353	0.229		-0.209	0.240	
DG3*DY4	-0.415	0.243	*	-0.427	0.229	*	-0.353	0.240	
Const	107.062	126.033		-55.087	40.664		247.975	156.145	
R-squared	0.863			0.887			0.834		

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